SOIL SURVEY OF
MIDLAND COUNTY, TEXAS

ELECTRONIC VERSION

This soil survey is an electronic version of the original printed copy, dated May 1968. It has been formatted for electronic delivery. Additional and updated information may be available from the Web Soil Survey. In Web Soil Survey, identify an Area of Interest (AOI) and navigate through the AOI Properties panel to learn what soil data is available.

United States Department of Agriculture
Soil Conservation Service
In cooperation with
Texas Agricultural Experiment Station

Issued April 1973

Major fieldwork for this soil survey was done in the period 1963-66. Soil names and descriptions were approved in 1966. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1966.

This survey was made cooperatively by the Soil Conservation Service and the Texas Agricultural Experiment Station. It is part of the technical assistance furnished to the Martin-Howard-Midland Soil and Water Conservation District.

Either enlarged or reduced copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, United States Department of Agriculture, Washington, D.C. 20250.

HOW TO USE THIS SOIL SURVEY

This soil survey contains information that can be applied in managing farms and ranches; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Midland County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The “Guide to Mapping Units” can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the page for the range site in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the range sites and the capability units.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Wildlife."

Ranchers and others can find, under "Use of the Soils for Range," groupings of the soils according to their suitability for range, and also the names of many of the plants that grow on each range site.

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

Newcomers in Midland County may be interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the section "Additional Facts About the County."

Cover: Hereford cattle on a Deep Hardland range site. This area of Abilene clay loam and Lipan clay receives runoff from the adjacent slopes.

Contents

Issued April 1973

SOIL SURVEY OF MIDLAND COUNTY, TEXAS

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UNITED STATES DEPARTMENT OF AGRICULTURE,
IN COOPERATION WITH THE TEXAS AGRICULTURAL EXPERIMENT STATION

MIDLAND COUNTY is in the western part of Texas and on the southeastern edge of the High Plains (fig. 1). The southernmost third of the county grades into the Edwards Plateau land resource area. The total area of the county is 600,320 acres, or 938 square miles. Midland, the county seat, is in the north-central part of the county.

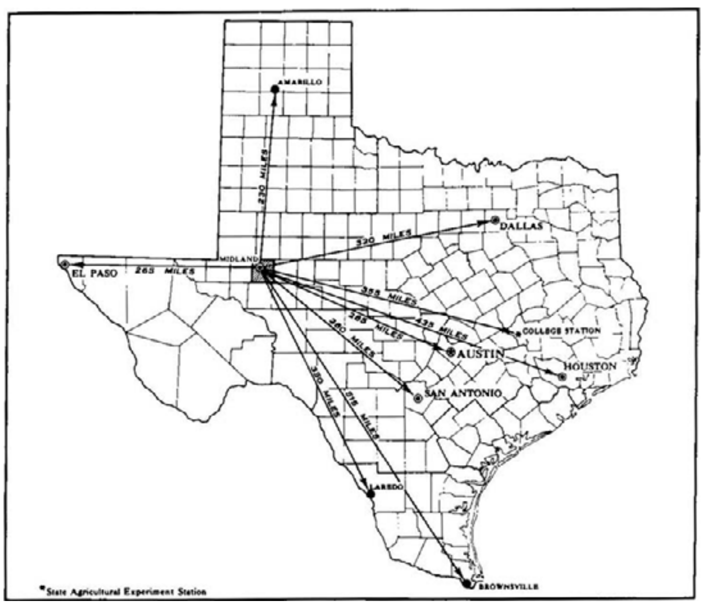

Figure 1.—Location of Midland County in Texas.

The relief of the county is, in general, nearly level to gently sloping. The upland landscape is dotted with small depressions that have no outlets. There are a few salt lakes, drainageways, and large, moderately steep draws. The range in elevation throughout the county is slight.

Most of the county, about 480,000 acres, is used for range. There are many large cattle ranches, even though stocking rates and grazing are limited by the semiarid climate. Approximately 11 percent of the county, about 70,000 acres, is cultivated. Irrigated cotton is the main crop, but grain and forage sorghum, bermudagrass, and small grains are also grown.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Midland County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the

size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures *(5)* The soil series and the soil phase are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place whore a soil of that series was first observed and mapped. Amarillo and Gomez for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example Amarillo fine sandy loam, 0 to 1 percent slopes, is one of several phases within the Amarillo series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. One such mapping unit shown on the soil map of Midland County is the soil complex.

A soil complex consists of areas of two or more soils, so intermingled or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Kimbrough-Slaughter complex is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, or so frequently worked by wind and water that it cannot be called soil. These areas are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Active dune land is a land type in Midland County.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soil in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been

assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of users, among them farmers, managers of rangeland, and engineers.

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others; then they adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Midland County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is not suitable for planning the management of a farm or field, or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The soil associations in Midland County are discussed in the following pages.

Soils of the High Plains

These associations are in the northern two-thirds of the county. They consist of broad physiographic areas of loamy and sandy soils that are used for ranching and for irrigated and dryland farming.

1. Amarillo-Arvana-Midessa association

Nearly level to gently sloping, deep to moderately deep fine sandy loams

This association consists of large areas of nearly level to gently sloping soils on uplands. These areas are broken by many small, rounded depressions and by occasional draws and drainageways.

This association occupies about 38 percent of the county. It is made up of about 63 percent Amarillo soils, 10 percent Arvana soils, 10 percent Midessa soils, and 17 percent minor soils.

The Amarillo soils are deep, reddish-brown fine sandy loams that have lower layers of friable sandy clay loam. The Arvana soils are reddish-brown fine sandy loams that have lower layers of sandy clay loam. They are moderately deep over indurated caliche. The Midessa soils are deep, grayish-brown, calcareous fine sandy loams that have lower layers of sandy clay loam. Minor soils are of the Abilene, Bippus, Gomez, Kimbrough, Lipan, Miles, Portales, Potter, Sharvana, and Simona series.

Most of this association is used for range, but about 30 percent is used for irrigated and dryland crops. If unprotected, the fine sandy loam surface layer is susceptible to soil blowing. Brush has invaded most areas of range.

2. Kimbrough-Slaughter association

Nearly level to gently sloping, very shallow and shallow loams

This association consists of very shallow and shallow soils over indurated caliche. These soils occupy broad areas on uplands. They are nearly level to gently sloping and contain playas and small drainageways.

This association occupies about 14 percent of the county. It is about 58 percent Kimbrough soils, 28 percent Slaughter soils, and 14 percent minor soils.

The Kimbrough soils have a surface layer of brown, calcareous loam, about 8 inches thick, overlying indurated platy caliche. The Slaughter soils are shallow, dark-brown loam in the surface layer. The surface layer is underlain by clay loam, and that layer, by indurated platy caliche. Minor soils are of the Lipan, Sharvana, Simona, and Stegall series.

Nearly all of this association is used for range. Brush has invaded most of the areas.

3. Springer-Miles association

Nearly level to gently sloping, deep loamy fine sands and fine sandy loams

This association consists of deep, nearly level to gently sloping soils on uplands. The soil surface ranges from level to convex and undulating.

This association occupies about 8 percent of the county. About 42 percent of it is Springer soils, 41 percent Miles soils, and 17 percent minor soils.

The Springer soils are deep, brown loamy fine sands and fine sandy loams that have lower layers of fine sandy loam. The Miles soils are deep, reddish-brown loamy fine sands that have lower layers of sandy clay loam. Minor soils are of the Amarillo, Arvana, Gomez, Midessa, and Simona series.

Most of this association is used for range, but a few small areas are used for crops. If unprotected, the surface layer is susceptible to soil blowing.

4. Reeves-Gypsum land association

Nearly level to moderately steep, very shallow to moderately deep loams and Gypsum land

This association consists of nearly level to moderately steep soils that are very shallow to moderately deep over gypsum. These soils occur in the vicinity of salt lakes and along draws.

This association occupies about 2 percent of the county. It is almost 41 percent Reeves soils, 39 percent Gypsum land, and 20 percent minor soils.

The Reeves soils are pale-brown, calcareous loams that have a lower layer of clay loam. They are shallow to moderately deep over gypsum. The surface of these soils is level to weakly convex. Gypsum land consists of outcrops of white gypsum that are covered with little or no soil. The surface of this gently sloping to moderately steep land type is convex. Minor soils in this association are of the Bippus and Midessa series.

Nearly all of this association is used for range. It is susceptible to soil blowing and water erosion.

5. Tivoli-Springer association

Duned and undulating, deep fine sands and loamy fine sands

This association consists mainly of duned and undulating soils on uplands. Some areas are nearly level to gently sloping.

This association occupies about 1 percent of the county. It is about 50 percent Tivoli soils, about 20 percent Springer soils, and about 30 percent minor soils.

The Tivoli soils are deep, brown fine sands that have lower layers of loose fine sand. They occur as undulating and duned areas. The Springer soils are deep, brown loamy fine sands that have lower layers of fine sandy loam. They are nearly level to gently sloping and are undulating. Minor soils are of the Amarillo, Gomez, Miles, and Simona series.

Nearly all of this association is used for range. It is highly susceptible to soil blowing. Brush has invaded some of the range.

6. Bippus-Potter association

Nearly level to steep, deep and very shallow clay loams and gravelly loams

This association consists of nearly level soils on flood plains and gently sloping to steep, very shallow, gravelly soils on hillsides.

This association occupies about 1 percent of the county. It is about 54 percent Bippus soils, about 22 percent Potter soils, and 24 percent minor soils.

The Bippus soils are deep, dark-brown clay loams that have lower layers of calcareous clay loam. These soils are on flood plains. The surface is level to weakly concave. The Potter soils are grayish-brown, calcareous gravelly loams that are very shallow (about 6 inches deep) over fractured, platy caliche. These gently sloping to steep soils are on hillsides above the flood plains. Minor soils are of the Kimbrough and Simona series.

Nearly all of this association is used for range. Vegetation is sparse on the very shallow Potter soils. The more strongly sloping areas are susceptible to water erosion.

Soils of the Edwards Plateau

These soil associations are in the southern third of the county. They consist of loamy soils in broad physiographic areas. In these areas the predominant enterprise is ranching.

7. Upton association

Gently sloping to sloping, shallow to very shallow loams

This association consists of gently sloping to sloping soils that are shallow to very shallow over indurated caliche. These soils are extensive along draws and drainage-ways.

This association occupies about 22 percent of the county. It is about 80 percent Upton soils and 20 percent minor soils.

The Upton soils are light brownish-gray, calcareous loams that have a lower layer of friable clay loam. They are shallow and very shallow to indurated platy caliche. The slopes are convex. Minor soils are of the Bippus, Lipan, Reagan, and Reeves series. Gypsum land and a few salt lakes make up a small part of the association.

Nearly all of this association is used for range. Because of the slope and sparse vegetation, it is susceptible to water erosion.

8. Reagan-Upton association

Nearly level to gently sloping, deep to very shallow loams and silty clay loams

This association consists of broad areas of nearly level to gently sloping soils and a few shallow depressions on upland plains.

This association occupies about 14 percent of the county. It is about 86 percent Reagan soils, 10 percent Upton soils, and 4 percent minor soils.

The Reagan soils are deep, light brownish-gray, calcareous silty clay loams that have lower layers of silty clay loam. They occupy level to weakly concave areas. The Upton soils are light brownish-gray, calcareous loams that have a lower layer of

friable clay loam and are very shallow to shallow over indurated platy caliche. They occupy level to weakly convex areas. Minor soils are of the Lipan and Reeves series.

Most of this association is used for range. Small areas of Reagan soils are used for irrigated crops.

Descriptions of the Soils

This section describes the soil series and mapping units of Midland County. The approximate acreage and proportionate extent of each mapping unit are given in table 1.

In the pages that follow, a general description of each soil series is given. Each series description has a short narrative description of a representative profile and a much more detailed description of the same profile, from which highly technical interpretations can be made. Following the profile is a brief statement of the range in characteristics of the soils in the series, as mapped in this county. Color names and color symbols given are for a dry soil unless otherwise indicated. Following the series description, each mapping unit in that series is described individually. For full information about any one mapping unit it is necessary to read the description of the soil series as well as the description of the mapping unit. Miscellaneous land types, such as Active dune land and Gypsum land, are described in alphabetic order along with other mapping units. (W) following the soil name on the "Guide to Mapping Units, (Removed)" indicates that signs of erosion, especially of local shifting of soil by wind, are evident in places, but, the degree of erosion cannot be estimated reliably.

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. At, the end of each description of a mapping unit are listed the capability units and range site into which the unit has been placed. To find descriptions of these groups refer to the "Guide to Mapping Units, (Removed)."

Abilene Series

The Abilene series consists of deep, moderately slowly permeable, neutral soils on uplands. These soils developed in calcareous, loamy sediments.

In a representative profile the surface layer is dark grayish-brown, firm clay loam about 10 inches thick. The next layer is clay loam to a depth of 60 inches. It is dark grayish brown and neutral in the uppermost 6 inches, is brown and mainly calcareous in the next 22 inches, and is pale brown and contains films and threads of calcium carbonate in the lower part.

The Abilene soils are well drained. Runoff is very slow to slow, and the available water capacity is high.

Representative profile of Abilene clay loam in a large depression 1.1 miles north of intersection of the county road with Interstate Highway 20; intersection is 6 miles east of the Midland courthouse:

Ap—0 to 10 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist: moderate, very fine, subangular blocky structure; hard, firm; common roots; neutral; abrupt, smooth boundary.

B21t—10 to 16 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, fine and medium, subangular blocky structure; very hard, firm; common roots; few, thin, patchy clay films; neutral: gradual, smooth boundary.

B22t—16 to 24 inches, brown (10YR 5/3) clay loam, dark brown (10YR 3/3) when moist; moderate, medium, blocky structure; extremely hard, firm; few roots; few, thin, patchy clay films; mildly alkaline; gradual, smooth boundary.

B23t—24 to 38 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) when moist; moderate, medium, blocky structure; extremely hard, firm; few roots; few, thin, patchy clay films; few films and threads of calcium carbonate; calcareous; moderately alkaline; clear, smooth boundary.

B3ca—38 to 60 inches, pale-brown (10YR 6/3) clay loam, dark brown (10YR 4/3) when moist; massive (structureless); very hard, firm; few films and threads of calcium carbonate; calcareous; moderately alkaline.

The A horizon ranges from 6 to 15 inches in thickness and from brown to dark grayish brown in color. Reaction ranges from neutral to mildly alkaline.

The B21t and B22t horizons range from dark grayish brown to brown. The B23t horizon ranges from brown to dark brown when dry.

The B3ca horizon is at a depth of 30 to 50 inches. Calcium carbonate in this horizon consists of films and threads and a few soft masses and concretions.

Abilene clay loam (Ab).—This soil generally occupies rounded or oval-shaped areas that range from nearly level to weakly concave and are bounded by soils on convex slopes. These areas average 15 to 30 acres in size. Slope is less than 1 percent.

Included in mapping were some depressed areas of Lipan clay and some areas of Portales loam, 0 to 1 percent slopes. These included soils make up less than 15 percent of any given area.

This soil is used mostly for range. Less than a quarter of the acreage is cultivated. Some of the cropland is irrigated. There is a slight hazard of soil blowing. (Capability unit IIe-2, irrigated, and IIIce-2, dryland; Deep Hardland range site)

Active Dune Land

Active dune land (Ad) consists of dunes and ridges of accumulated sand and areas of blown-out land. Soil blowing is active. This land type occupies an area of about 150 acres. Aerial photographs show that the duned area has increased by about 12 percent since 1946.

Active dune land is made up of about 80 percent active dunes and 20 percent blown-out land. The dunes are 5 to 20 feet high, and they have slopes of 3 to 20 percent. They consist of brown to reddish-brown loamy fine sand to fine sand. The blown-out areas generally have a floor of reddish-brown light sandy clay loam or fine sandy loam.

The dunes are more unstable on the east and north sides. Scattered plants grow on some dunes, but less than 10 percent of the area has vegetation. Continuous soil blowing makes this land type unsuitable for any use other than wildlife habitat. (Capability unit VIIIe-1)

Amarillo Series

The Amarillo series consists of deep, friable, moderately permeable, neutral soils on uplands. These soils developed in loamy, calcareous sediments.

In a representative profile the surface layer is reddish-brown fine sandy loam about 10 inches thick. Beneath this is a layer of sandy clay loam that extends to a depth of 64 inches. This layer is reddish brown in the upper 14 inches. It is yellowish red and calcareous in the next 20 inches; it is pink and contains about 30 percent calcium carbonate in the next 11 inches; and it is light reddish brown and calcareous in the lower 9 inches.

These soils are well drained. The available water capacity is high. The fine sandy loam surface layer is moderately susceptible to soil blowing.

Representative profile of Amarillo fine sandy loam, 0 to 1 percent slopes, 1.05 miles north, east, and north again, of the intersection of the pasture oilfield road with

Farm Road 307; intersection is 3.14 miles east of Greenwood School and 12.14 miles east of the Midland city limits:

A1—0 to 10 inches, reddish-brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4) when moist; weak subangular blocky structure; hard, friable; common very fine to medium pores; neutral; gradual, smooth boundary.

B21t—10 to 24 inches, reddish-brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) when moist; moderate, very coarse, prismatic structure breaking to weak, medium, subangular blocky; very hard, friable; common very fine to medium pores; common worm casts; few clay films on ped faces; neutral; gradual, smooth boundary.

B22t—24 to 40 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) when moist; moderate, very coarse, prismatic structure breaking to weak, medium, subangular blocky; very hard, friable; few pores; clay films on ped faces; calcareous; moderately alkaline; clear, smooth boundary.

B23t—40 to 44 inches, yellowish-red (5YR 5/8) sandy clay loam, yellowish red (5YR 4/8) when moist; weak, very coarse, prismatic structure; very hard, friable; few fine pores; clay films on ped faces; common threads and films of calcium carbonate; calcareous; moderately alkaline; clear, smooth boundary.

B24tca—44 to 55 inches, pink (5YR 8/3) sandy clay loam, light reddish brown (5YR 6/4) when moist; weak, very coarse, prismatic structure; slightly hard, friable; 30 percent by volume is soft masses and concretions of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

B25t—55 to 64 inches, light reddish-brown (5YR 6/4) sandy clay loam, yellowish red (5YR 5/6) when moist; weak, very coarse, prismatic structure; hard, friable; 5 percent by volume is soft masses and concretions of calcium carbonate; calcareous; moderately alkaline.

The A horizon ranges from 7 to 16 inches in thickness. When the soil is dry, the color ranges from reddish brown to brown. Reaction ranges from neutral to mildly alkaline.

The B2t horizon ranges from reddish brown to red in color and from light to medium sandy clay loam in texture. It ranges from neutral to moderately alkaline and is calcareous at a depth of 18 to 28 inches.

The depth to the Btca horizon ranges from 30 to 59 inches. This horizon is 20 to 60 percent by volume segregated soft masses and concretions of calcium carbonate.

The depth to the Bt horizon below the Btca horizon ranges from 40 to 70 inches. This Bt horizon is 5 to 15 percent by volume segregated calcium carbonate.

Amarillo fine sandy loam, 0 to 1 percent slopes (AfA).—This soil occupies broad plains (fig. 2). It has the profile described as representative for the series. Areas of this soil are irregular or oval in shape. They range in size from 30 to 800 acres, but are dominantly about 300 acres. In many places the surface has a weakly undulating appearance.

Included in mapping were small depressions and playas of Abilene clay loam and Lipan clay. Also included were small areas of Sharvana fine sandy loam. Inclusions make up less than 15 percent of any given area.

Most of the acreage is used for irrigated and dryland crops. Some of this soil is still in native grasses. (Capability unit IIe-4, irrigated, and IIIe-4, dryland; Sandy Loam range site)

Amarillo fine sandy loam, 1 to 3 percent slopes (AfB).—This soil occupies broad areas that are irregular in shape. These areas are 30 to 800 acres in size. The surface is weakly convex to plane.

Figure 2.—Cultivated area of Amarillo fine sandy loam, 0 to 1 percent slopes.

The surface layer is reddish-brown fine sandy loam about 10 inches thick. Below this is a layer of friable sandy clay loam. This layer is reddish brown to a depth of 42 inches. The middle part is pink and is about 30 percent calcium carbonate. The lower part of the layer is light reddish brown and calcareous.

Small areas of Sharvana fine sandy loam were included in mapping. Inclusions make up less than 15 percent of any given area.

Approximately a third of the acreage is used for crops, and some of this is irrigated. The rest of this soil is used for range. The water erosion hazard is moderate. (Capability unit IIIe-3, irrigated, and IIIe-4, dryland; Sandy Loam range site)

Arvana Series

The Arvana series consists of moderately permeable upland soils that are moderately deep over indurated caliche. These soils developed in loamy, calcareous sediments.

In a representative profile the surface layer is reddish-brown fine sandy loam about 10 inches thick. The next layer is reddish-brown sandy clay loam in the upper 15 inches and yellowish-red, calcareous sandy clay loam in the lower 7 inches. The underlying material is indurated caliche to a depth of 34 inches.

The Arvana soils are well drained. The available water capacity is moderate.

Representative profile of Arvana fine sandy loam, 0 to 1 percent slopes, in a plowed field, 2.75 miles south of the intersection of Texas Highway 349 with Farm Road 1205; 9.75 miles south of the courthouse in Midland:

Ap—0 to 10 inches, reddish-brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4) when moist; weak, very fine, subangular blocky structure; slightly hard, friable; few roots; mildly alkaline; abrupt, smooth boundary.

B2t—10 to 25 inches, reddish-brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) when moist; moderate, very coarse, prismatic structure breaking to weak, fine, subangular blocky; very hard, friable; few tine pores; few roots; few patchy clay films; mildly alkaline; clear, smooth boundary.

B3t—25 to 32 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) when moist; moderate, very coarse, prismatic structure breaking to weak, fine, subangular blocky; very hard, friable; few fine pores; few roots; few patchy clay films; few films and threads of calcium carbonate on ped faces; calcareous; moderately alkaline; abrupt, wavy boundary.

Ccam—32 to 34 inches, indurated caliche, laminar in the uppermost 3 inches, platy below; plates range from 3 to 8 inches in thickness and have pendants of strongly cemented calcium carbonate on under sides.

The A horizon ranges from 8 to 12 inches in thickness and from brown to reddish brown in color.

The B2t horizon ranges from 12 to 28 inches in thickness and from reddish brown to yellowish red in color.

The Ccam horizon is at a depth of 20 to 40 inches. The strongly cemented to indurated caliche plates are up to 20 inches or more in diameter.

Arvana fine sandy loam, 0 to 1 percent slopes (ArA).—This soil occupies plains areas that are irregular or oval in shape. These areas average 80 to 100 acres in size. This soil has the profile described as representative for the series. The surface is level to convex.

Included in mapping were some areas of Lipan clay and Abilene clay loam in weak depressions and playas. Also included were small areas of Sharvana fine sandy loam. Inclusions make up less than 15 percent of any given area.

About half the acreage is used for irrigated and dryland crops. The rest is in native range. (Capability unit IIe-4, irrigated and IIIe-4, dryland; Sandy Loam range site)

Arvana fine sandy loam, 1 to 3 percent slopes (ArB).—This soil occupies irregularly shaped areas that have weakly convex slopes. These areas range from 20 to 200 acres in size.

The surface layer is reddish-brown fine sandy loam about 9 inches thick. The next layer is reddish-brown sandy clay loam about 20 inches thick. The underlying material is indurated caliche that is laminar in the upper 3 inches.

Small areas of Sharvana fine sandy loam were included in mapping. Inclusions make up less than 15 percent of any given area.

About half the acreage is used for irrigated and dryland crops, and the rest is in native range. The water erosion hazard is moderate. (Capability unit IIIe-3, irrigated, and IIIe-4, dryland; Sandy Loam range site)

Bippus Series

The Bippus series consists of deep, moderately permeable soils on uplands. These soils developed in loamy, calcareous, alluvial sediments.

In a representative profile the surface layer is dark-brown clay loam about 24 inches thick. The nest layer is brown, calcareous clay loam to a depth of 55 inches. Below this, to a depth of 65 inches, is pink clay loam that is about 3 percent calcium carbonate.

The Bippus soils are well drained. Runoff is moderate to rapid, and the available water capacity is high.

Representative profile of Bippus clay loam in Mustang Draw, 100 feet north of Farm Road 307, 6.3 miles east of Greenwood School, and 15.3 miles east of the Midland city limits:

A1—0 to 24 inches, dark-brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) when moist; moderate, coarse, prismatic structure breaking to moderate, medium, subangular blocky; very hard, firm; many very fine to medium pores; many roots; moderately alkaline; diffuse, smooth boundary.

B21—24 to 55 inches, brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/4) when moist; weak, medium, subangular blocky structure; hard, friable; few fine pores; few roots; calcareous; moderately alkaline; gradual, smooth boundary.

B22ca—55 to 65 inches, pink (7.5YR 7/3) clay loam, light brown (7.5YR 6/3) when moist; weak, medium, subangular blocky structure; hard, friable; about 3 percent by volume is threads and soft masses of calcium carbonate; calcareous; moderately alkaline.

The A1 horizon ranges from 20 to 30 inches in thickness and from very dark grayish brown to brown in color. It is mildly alkaline to moderately alkaline.

The B21 horizon ranges from grayish brown to brown.

The depth to the B22ca horizon is 48 inches or more. It is 1 to 3 percent by volume calcium carbonate.

Bippus clay loam (Bc).—This soil is on bottoms of draws and in drainageways, as well as on the flood plains of intermittent streams. This soil is weakly concave or level, and slopes are less than 1 percent. Areas are long and narrow, in some places as much as several miles long. They range from 30 to 150 acres in size, but they are dominantly about 50 acres. This soil is subject to occasional flooding, but the floodwaters quickly recede. In many places runoff is received from the higher adjacent slopes.

Some lower lying saline areas were included with this soil in mapping. Inclusions make up less than 10 percent of any given area.

Most of the acreage is used for range. Some areas of this soil are cultivated, however, and a few are irrigated. (Capability unit IIe-2, irrigated, and IIIce-2, dryland; Bottomland range site)

Gomez Series

The Gomez series consists of deep, moderately rapidly permeable soils on uplands. These soils developed in calcareous, loamy sediments.

In a representative profile the surface layer is brown, calcareous fine sandy loam about 10 inches thick. The next layer is light-brown, friable fine sandy loam about 26 inches thick. It is underlain by a layer of pink loam about 13 inches thick that has an accumulation of about 25 percent calcium carbonate. Below this, to a depth of 60 inches, is light-brown loam that is about 5 percent calcium carbonate.

These soils are well drained. The available water capacity is moderate. The Gomez soils absorb moisture well, but they have a high calcium carbonate content that causes chlorosis in some crops.

Representative profile of Gomez fine sandy loam, 0 to 1 percent slopes, 100 feet north of pasture oilfield road and 0.15 mile northeast of Texas Highway 158 from a point 13.5 miles southeast of Midland city limits:

A1—0 to 10 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) when moist; weak, very fine, subangular blocky structure; slightly hard, friable; common medium to very fine pores; few very fine caliche fragments; common worm casts; common roots; calcareous; moderately alkaline; gradual, smooth boundary.

B2—10 to 36 inches, light-brown (7.5YR 6/4) fine sandy loam, brown (7.5YR 5/4) when moist; weak, fine, subangular blocky structure; slightly hard, friable; common very fine to fine pores; common roots; common worm casts; few very fine caliche fragments; calcareous; moderately alkaline; clear, smooth boundary.

C1ca—36 to 49 inches, pink (7.5YR 8/4) loam, pink (7.5YR 7/4) when moist; massive (structureless); hard, friable; 25 percent is soft masses and concretions of calcium carbonate; calcareous; moderately alkaline; diffuse, smooth boundary.

C2—49 to 60 inches, light-brown (7.5YR 6/4) loam, brown (7.5YR 5/4) when moist; massive (structureless) slightly hard, friable; 5 percent is soft masses and concretions of calcium carbonate; calcareous; moderately alkaline.

The A horizon is 8 to 15 inches in thickness. When the soil is dry the color ranges from brown to light brown. The texture ranges from fine sandy loam to loamy fine sand.

The B2 horizon ranges from light brown to brown.

The depth to the C1ca horizon is 24 to 40 inches. Soft masses and concretions of calcium carbonate make up 20 to 40 percent by volume of this horizon. The C1ca horizon is 12 to 25 inches thick.

The C2 horizon is 5 to 10 percent calcium carbonate.

Gomez fine sandy loam, 0 to 1 percent slopes (GmA).—This soil occupies plains areas that are irregular or oval in shape. These areas range from 20 to 200 acres or more in size. This soil has the profile described as representative for the series. Surfaces are level to weakly convex.

Small areas of Simona fine sandy loam were included in mapping. In about 30 percent of the mapped area, the depth to accumulated calcium carbonate is more than 40 inches.

About half of the acreage is used for irrigated and dryland crops, and the rest is left in native range. There is a moderate hazard of soil blowing. (Capability unit IIe-5, irrigated, and IIIe-6 dryland; Mixed Plains range site)

Gomez fine sandy loam, 1 to 3 percent slopes (GmB).—This soil occurs in areas that are irregular in shape. These areas are 20 to 100 acres in size. The slopes are convex.

The surface layer is brown, calcareous fine sandy loam about 10 inches thick. The next layer is light-brown, friable, calcareous fine sandy loam about 24 inches thick. The next lower layer, about 13 inches thick, is pink loam that is about 25 percent accumulated calcium carbonate. This is underlain by light-brown loam that is about 5 percent calcium carbonate.

Included in mapping were small areas of Simona fine sandy loam. This inclusion makes up less than 20 percent of any given area.

This soil is used mostly for range. A small acreage is cultivated, and some of this soil is irrigated. The hazard of soil blowing is moderate, and the hazard of water erosion is slight. (Capability unit IIIe-6, irrigated, and IIIe-6, dryland; Mixed Plains range site)

Gomez loamy fine sand (0 to 3 percent slopes) (Go).—This soil occurs in areas that are irregular in shape and that range in size from 30 to 100 acres. Surfaces are level to convex.

The surface layer is brown, calcareous loamy fine sand about 12 inches thick. The next layer is light-brown, friable, calcareous fine sandy loam about 24 inches thick. The next lower layer is pink loam about 13 inches thick that is about 25 percent accumulated calcium carbonate. It is underlain by light-brown loam that is about 5 percent calcium carbonate.

A few small areas of Springer loamy fine sand, Miles loamy fine sand, and Simona fine sandy loam were included in mapping. Inclusions make up less than 20 percent of any given area.

This soil is used mostly for range. The hazard of soil blowing is severe. (Capability unit IIIe-8, irrigated, and IVe-7, dryland; Sandyland range site)

Gypsum Land

Gypsum land (Gy) consists of outcrops of white gypsum covered with little or no soil. This land type occurs on convex slopes adjacent to salt lakes and other depressional areas (fig. 3). The slope ranges from 1 to 20 percent.

About 40 percent of this land type is gypsum outcrop. About 33 percent of the area has less than 4 inches of soil material over the gypsum. About 19 percent of the area has a surface layer of loam 4 to 10 inches thick, and about 8 percent has a surface layer of pale-brown loam 10 to 20 inches thick.

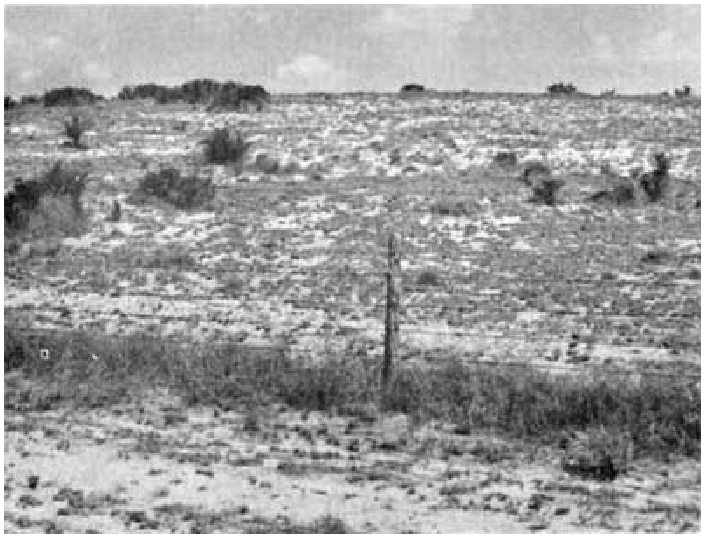

Figure 3.—An area of Gypsum land, The vegetation is typically sparse.

Small, nearly level areas of Reeves loam were included in mapping.

This land type is not suitable for cultivation, and is used only for range. It is highly susceptible to water erosion and soil blowing. (Capability unit VIIs-3; dryland; Gyp range site)

Kimbrough Series

The Kimbrough series consists of very shallow, moderately permeable, calcareous soils on uplands. These soils developed as a thin layer of soil over thick beds of indurated, platy caliche (fig. 4).

In a representative profile the surface layer is brown, calcareous loam about 8 inches thick. The underlying material, to a depth of 10 inches, is indurated platy caliche that is strongly cemented by calcium carbonate.

These soils are well drained. The available water capacity is low.

Representative profile of Kimbrough loam, 100 feet west and 6.5 miles south of the intersection of the Salt Lake road with Farm Road 1205; intersection is 6 miles south and east of the Midland city limits:

A1—0 to 8 inches, brown (7.5YR 5/3) loam, dark brown (7.5YR 3/3) when moist; weak and moderate, medium, subangular blocky structure; very hard, friable; common roots; lower part is 2 percent caliche fragments; calcareous; mildly alkaline; abrupt, wavy boundary.

Ccam—8 to 10 inches, white (N 8/0) indurated platy caliche that has a few fractures; very strongly consented and laminar in upper part.

The A1 horizon is 7 to 10 inches thick. It ranges from brown to grayish brown. Reaction ranges from mildly alkaline to moderately alkaline. The A1 horizon is 2 to 15 percent coarse fragments.

The Ccam horizon is platy caliche that ranges from strongly cemented to indurated. The plates range from 6 to 24 inches in diameter and from 3 to 8 inches in thickness.

Kimbrough loam (Kb).—This nearly level to gently sloping soil occupies areas that are irregular in shape and that range from 40 to 400 acres in size. The soil surface is convex to level, and the slope ranges from 0 to 3 percent. This soil has the profile described as representative for the series.

Figure 4.—Profile of Kimbrough loam. The underlying material is hard, platy to massive (structureless) caliche.

Small areas of Sharvana fine sandy loam and Slaughter loam were included in mapping. Also included were small depressional areas of Lipan clay and Abilene clay loam. Inclusions make up less than 20 percent of any given area.

Nearly all of this soil is used for range. Runoff is slow to moderate. (Capability unit VIIs-1, dryland: Shallowland range site)

Kimbrough-Slaughter complex (Ks).—These nearly level to gently sloping soils occur in such an intricate pattern that it was not practical to map them separately. This complex is made up of about 55 percent Kimbrough soils, 35 percent Slaughter loam, and 10 percent other soils. Areas of these soils are long and narrow. Soil surfaces are weakly concave, level, and convex. Slopes are 0 to 3 percent.

The Kimbrough soils are about 300 feet wide. The surface layer is brown loam about 8 inches thick, and the underlying material is indurated platy caliche strongly cemented by calcium carbonate. Fragments and cobble-stones of caliche rock cover about 5 percent of the surface.

The Slaughter soil is nearly level to weakly concave. The areas are about 100 feet wide. The surface layer is friable, brown loam about 5 inches thick. The next layer is reddish-brown clay loam about 10 inches thick. The underlying material is platy caliche that is indurated and laminar or banded in the upper 2 inches and strongly cemented in the lower part.

About 10 percent of this complex consists of small areas of Simona fine sandy loam, Lipan clay, Abilene clay loam, and Stegall loam that were included in mapping.

This complex is used mostly for range. (Capability unit VIIs-1, dryland; Shallowland range site)

Lipan Series

The Lipan series consists of deep, very slowly permeable, calcareous soils in depressions and playas. These soils developed in clayey sediments (fig. 5).

In a representative profile the surface layer is dark-gray to gray, very firm clay about 30 inches thick. The next layer, about 20 inches thick, is light-gray clay that has shiny pressure faces on the ped surfaces. The underlying material, to a depth of 60 inches, is light-gray clay that is about 7 percent calcium carbonate.

Figure 5.—Profile of Lipan clay.

These soils are moderately well drained. They are periodically flooded by runoff from adjacent slopes.

Representative profile of Lipan clay, 150 feet south and 3.5 miles west of the intersection of Interstate 20 bypass and Texas Highway 349; intersection is 2 miles south of the Midland courthouse:

A11—0 to 6 inches, dark-gray (10YR 4/1) clay, very dark gray (10YR 3/1) when moist; moderate, medium to coarse, blocky structure, upper 2 inches forms a mulch of very hard, very fine angular aggregates when dry; very

hard, very firm, very sticky and very plastic; common very fine and fine pores; many roots; calcareous; moderately alkaline; clear, smooth boundary.

A12—6 to 30 inches, gray (10YR 5/1) clay, dark gray (10YR 4/1) when moist; moderate, medium and coarse, blocky structure; very hard, very firm, very sticky and very plastic; few very fine pores; many roots; peds have shiny pressure faces; calcareous; moderately alkaline; gradual, wavy boundary.

AC—30 to 50 inches, light-gray (2.5YR 7/2) clay, light brownish gray (2.5YR 6/2) when moist; weak, medium, blocky structure; very hard, very firm, very sticky and very plastic; wedge-shaped peds tilted more than 10 degrees from horizontal; shiny pressure faces on peds; few roots; common films and threads of calcium carbonate; calcareous; moderately alkaline; gradual, wavy boundary.

Cca—50 to 60 inches, light-gray (2.5YR 7/2) clay, light brownish gray (2.5YR 6/2) when moist; massive (structureless); very hard, very firm, sticky and plastic; about 7 percent by volume is films and threads and fine soft masses and concretions of calcium carbonate; calcareous; moderately alkaline.

The A1 horizon ranges from 14 to 40 inches in thickness and from gray to dark gray in color; the uppermost 8 inches is mildly alkaline to moderately alkaline.

The AC horizon ranges from light brownish gray to grayish brown.

The depth to the Cca horizon is 40 to 60 inches. This horizon is 5 to 10 percent calcium carbonate.

Lipan clay (Lp).—This soil is on the bottom of playas, in shallow depressional areas that are rounded or oval in shape. The unplowed surface has gilgai relief (fig. 6) that consists of a succession of microbasins and microridges, in which mounds 5 to 8 feet in diameter rise 3 to 18 inches higher than the depressions. Half-inch cracks that are more than 20 inches deep remain open about half the time. Areas of this soil are about 10 to 50 acres in size. The surface ranges from weakly concave to level, and slope is less than 1 percent.

A few small areas of Abilene clay loam and Portales loam were included with this soil in mapping.

This soil is used mostly for range. It is suited to livestock grazing when it, is not flooded. Because of the periodic flooding, this soil is not suited to crops. Water enters the soil rapidly where it is cracked, but after the cracks swell and close, the movement of water into the soil is very slow.

Soil blowing is a hazard where the surface is dry and bare. (Capability unit VIw-1, dryland; range site not assigned)

Figure 6.—An area of Lipan clay. This soil has gilgai microrelief.

Midessa Series

The Midessa series consists of deep, moderately permeable soils on uplands. These soils developed in loamy, calcareous sediments.

In a representative profile the surface layer is grayish-brown fine sandy loam about 8 inches thick. The next layer is pale-brown sandy clay loam about 24 inches thick. The next lower layer is pink loam about 13 inches thick that contains about 25 percent calcium carbonate. This is underlain by light-brown, calcareous loam to a depth of 62 inches.

The Midessa soils are well drained. The available water capacity is high. Although these soils absorb moisture well, a high content of calcium carbonate causes chlorosis in some plants. The hazard of soil blowing is moderate.

Representative profile of Midessa fine sandy loam, 0 to 1 percent slopes, 2 miles north of the intersection of ranch road with Texas Highway 158; intersection is 5 miles northwest of the Midland city limits:

A1—0 to 8 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) when moist; weak, very fine, subangular blocky structure; slightly hard, friable; common fine pores; many roots; few very fine calcium carbonate concretions; calcareous; moderately alkaline; clear, smooth boundary.

B2—8 to 32 inches, pale-brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) when moist; weak, fine, subangular blocky structure; slightly hard, friable; common very fine pores; common roots; few very fine calcium carbonate concretions; calcareous; moderately alkaline; clear, smooth boundary.

C1ca—32 to 45 inches, pink (7.5YR 7/4) loam, light brown (7.5YR 6/4) when moist; massive (structureless); slightly hard, friable; 25 percent by volume is soft masses and concretions of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

C2—45 to 62 inches, light-brown (7.5YR 6/4) loam, brown (7.5YR 5/4) when moist; massive (structureless); slightly hard, friable; 5 percent by volume is calcium carbonate; calcareous; moderately alkaline.

The A horizon is 6 to 10 inches thick. The colors range from brown to light brownish gray.

The B2 horizon is 15 to 30 inches thick. The colors range from light brownish gray to light brown. The texture ranges from sandy clay loam to loam.

The depth to the C1ca horizon ranges from 25 to 40 inches. The thickness of this horizon ranges from 6 to 15 inches. This horizon is 5 to 40 percent by volume visible calcium carbonate.

The C2 horizon contains 5 to 15 percent calcium carbonate.

Midessa fine sandy loam, 0 to 1 percent slopes (MdA).—This soil occupies plains areas that are irregular or oval in shape. These areas range from 20 to more than 300 acres in size but are dominantly about 80 acres. Soil surfaces are level to weakly convex. This soil has the profile described as representative for the series.

Small areas of Simona fine sandy loam were included in mapping. Inclusions make up less than 15 percent of any given area.

About a third of the acreage is used for irrigated and dryland crops. The rest of this soil is in native range. (Capability unit IIe-5, irrigated, and IIIe-6, dryland; Mixed Plains range site)

Midessa fine sandy loam, 1 to 3 percent slopes (MdB).—This soil is in depressions and along drainageways. The areas are less than 100 acres in size. Slopes are weakly convex.

The surface layer is grayish-brown, calcareous fine sandy loam about 7 inches thick. The next layer is pale-brown, friable sandy clay loam about 28 inches thick. The next layer is pink loam that is about 25 percent calcium carbonate. It is underlain by light-brown, calcareous loam.

Included in mapping were small areas of Simona fine sandy loam. Inclusions make up less than 15 percent of any given area.

About a third of the acreage is used for irrigated and dryland crops. The rest of this soil is in native range. The water erosion hazard is slight. Runoff is medium. (Capability unit IIIe-6, irrigated, and IIIe-6, dryland; Mixed Plains range site)

Miles Series

The Miles series consists of deep, moderately permeable soils on uplands. These soils developed in loamy sediments.

In a representative profile the surface layer is reddish-brown, neutral loamy fine sand about 14 inches thick. The next layer is friable fine sandy loam and sandy clay loam that extends to a depth of 62 inches. It is reddish-brown fine sandy loam to a depth of 20 inches, yellowish-red sandy clay loam to a depth of 48 inches, and reddish-yellow sandy clay loam below that depth.

The Miles soils are well drained. They absorb moisture well, and the available water capacity is moderate.

Representative profile of Miles loamy fine sand, 0 to 3 percent slopes, 0.1 mile south of the intersection of pasture oilfield road with Farm Road 307; intersection is 5.25 miles east of Greenwood School and 14.25 miles east of the Midland city limits:

A1—0 to 14 inches, reddish-brown (5YR 5/4) loamy fine sand, dark reddish brown (5YR 3/4) when moist; weak, very fine, subangular blocky structure; soft, very friable; common roots; neutral; gradual, smooth boundary.

B1—14 to 20 inches, reddish-brown (5YR 5/5) fine sandy loam, reddish brown (5YR 4/5) when moist; moderate, very coarse, prismatic structure breaking to weak, fine, subangular blocky; hard, friable; common roots; neutral; gradual, smooth boundary.

B21t—20 to 28 inches, reddish-brown (5YR 5/5) sandy clay loam, reddish brown (5YR 4/5) when moist; moderate, very coarse, prismatic structure breaking to weak, fine, subangular blocky hard, friable; few very thin clay films on peds; few roots; neutral; gradual, smooth boundary.

B22t—28 to 48 inches, yellowish-red (5YR 5/8) sandy clay loam, yellowish red (5YR 4/8) when moist; weak, very coarse, prismatic structure breaking to weak, fine, subangular blocky; hard, friable; thin clay films on peds; mildly alkaline; gradual, smooth boundary.

B23t—48 to 62 inches, reddish-yellow (5YR 6/8) sandy clay loam, yellowish red (5YR 5/8) when moist; weak, very coarse, prismatic structure; hard, friable; few patchy clay films on peds; mildly alkaline.

The A horizon is 10 to 18 inches thick. When the soil is dry the color ranges from brown to reddish brown.

The B horizon ranges from reddish brown to reddish yellow.

Miles loamy fine sand, 0 to 3 percent slopes (MmB).—This soil occupies irregularly shaped areas on undulating plains. These areas average about 150 acres in size, but they range from 30 to 900 acres. Soil surfaces are level to convex, and the average slope is about 2 percent (fig. 7).

Figure 7.—A cultivated area of Miles loamy fine sand, 0 to 3 percent slopes.

A few small areas of Lipan clay, Abilene clay loam, and Sharvana fine sandy loam were included with this soil in mapping. Inclusions make up less than 20 percent of any given area.

Most of the acreage is in native range. A few areas are used for irrigated and dryland crops. Runoff is slow to moderate. There is a slight water erosion hazard in the gently sloping areas. The hazard of soil blowing is severe. (Capability unit IIIe-8, irrigated, and IVe-7, dryland; Sandyland range site)

Portales Series

The Portales series consists of deep, moderately permeable soils on uplands. These soils developed in calcareous, loamy sediments.

In a representative profile the surface layer is grayish-brown, calcareous loam about 12 inches thick. The next layer is grayish-brown clay loam about 24 inches thick. The next lower layer, about 8 inches thick, is white clay loam that is about 30

percent calcium carbonate. This is underlain, to a depth of 60 inches, by very pale brown, massive clay loam that is about 10 percent calcium carbonate.

These soils are well drained. The available water capacity is high.

Representative profile of Portales loam, 0 to 1 percent slopes, 100 feet west of unpaved county road and 0.35 mile south of the Midland city limits and the Interstate 20 bypass. The county road intersects the bypass 1 mile south of Texas Highway 158:

A1—0 to 12 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, prismatic structure breaking to weak, very fine, subangular blocky; slightly hard, friable; common roots; few very fine and fine concretions of calcium carbonate; calcareous; moderately alkaline; clear, smooth boundary.

B2—12 to 36 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) when moist; weak, fine, subangular blocky structure; hard, firm; few roots; few very fine and fine concretions of calcium carbonate; calcareous; moderately alkaline; clear, smooth boundary.

C1ca—36 to 44 inches, white (10YR 8/1) clay loam, light gray (10YR 7/2) when moist; weak, fine, subangular blocky structure; hard, friable; 30 percent by volume is soft masses and concretions of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

C2—44 to 60 inches, very pale brown (10YR 8/3) clay loam, very pale brown (10YR 7/3) when moist; massive (structureless); hard, friable; 10 percent by volume is soft masses and concretions of calcium carbonate; calcareous; moderately alkaline.

The A horizon is 10 to 14 inches thick. The color ranges from brown to grayish brown.

The B2 horizon ranges from grayish brown to light brown in color. The texture ranges from sandy clay loam to clay loam.

The depth to the C1ca horizon is 30 to 40 inches. The calcium carbonate content of this layer ranges from 20 to 40 percent. The thickness ranges from 6 to 20 inches.

The C2 horizon is mainly less than 15 percent by volume calcium carbonate.

Portales loam, 0 to 1 percent slopes (PoA).—This nearly level soil occupies rounded to irregularly shaped areas on plains. These areas are 20 to 100 acres or more in size. Soil surfaces are level to weakly concave.

Included in mapping were small areas of Lipan clay in depressions and convex areas of Simona fine sandy loam. Inclusions make up less than 15 percent of any given area.

About half of the acreage is used for irrigated and dry-land crops, and the other half for range. The hazard of soil blowing is moderate. (Capability unit IIe-3, irrigated, and IIIce-3, dryland; Mixed Plains range site)

Potter Series

The Potter series consists of very shallow, calcareous, moderately permeable soils on uplands. These soils have a thin mantle of loamy material over beds of caliche.

In a representative profile the surface layer is grayish-brown gravelly loam about 6 inches thick. The next layer is pinkish-white, fractured platy caliche about 12 inches thick. Pendants of calcium carbonate are on the undersides of the plates. This layer is underlain by pink platy caliche to a depth of 50 inches.

The Potter soils are well drained. Their shallowness limits their use and the kinds and amounts of plants that will grow on them. The available water capacity is low.

Representative profile of Potter soils along the slopes of Mustang Draw 2.3 miles north of the intersection of the county road with Farm Road 307; intersection is 4 miles east of Greenwood School and 13 miles east of the Midland city limits:

A1—0 to 6 inches, grayish-brown (10YR 5/2) gravelly loam, dark grayish brown (10YR 4/2) when moist; weak, very fine, subangular blocky structure; very hard, firm; common fine pores; common roots; 18 percent is coarse to fine fragments of indurated caliche; calcareous; moderately alkaline; abrupt, wavy boundary.

Cca—6 to 18 inches, pinkish-white (7.5YR 8/2) fractured platy caliche, pinkish gray (7.5YR 7/2) when moist; undersides of plates have pendants of calcium carbonate about ¼ inch long; few roots between plates; calcareous; moderately alkaline; clear, smooth boundary.

R—18 to 50 inches, pink (7.5YR 8/4) platy caliche that has a hardness of slightly less than 3 on the Mohs scale; calcareous; moderately alkaline.

The A1 horizon is 4 to 12 inches thick. It ranges from grayish brown to brown in color and from gravelly loam to clay loam in texture. The content of indurated caliche fragments ranges from 0 to 35 percent.

The depth to the R layer is 7 to 20 inches.

Potter soils (Pt). These soils occupy slopes along drainageways and around depressions. Areas of these soils are 10 to 100 acres in size, and the largest areas are along Mustang Draw (fig. 8). These soils have fragments of caliche rock on the surface. The surface layer ranges from gravelly loam to clay loam. Soil surfaces are convex, and the slope ranges from 1 to 30 percent or more.

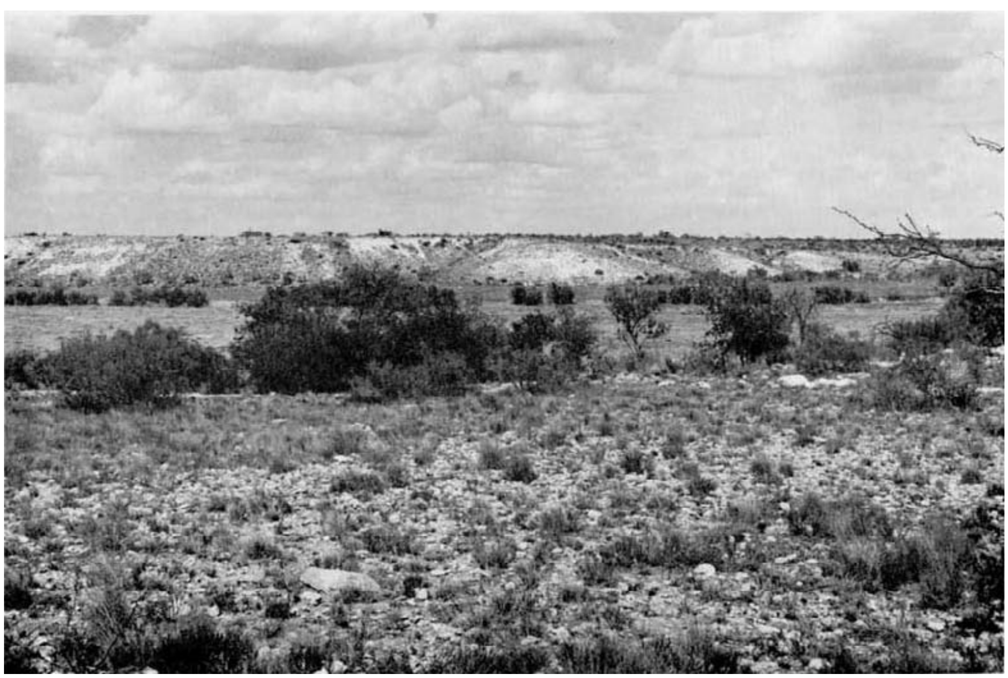

Figure 8.—Sloping areas of Potter soils along Mustang Draw. Bippus clay loam is in the foreground.

Small areas of Kimbrough loam and Simona fine sandy loam were included with these soils in mapping. Inclusions make up less than 10 percent of any given area.

These soils are used mostly for range. They are too shallow to be suitable for crops. Surface runoff is moderate to rapid. (Capability unit VIIs-1, dryland; Shallowland [gravelly] range site)

Reagan Series

The Reagan series consists of deep, moderately permeable soils on uplands. These soils developed in calcareous, loamy sediments.

In a representative profile the surface layer is light brownish-gray, calcareous silty clay loam about 8 inches thick. The next layer is light-brown silty clay loam about 26 inches thick. The next layer is pinkish-white, weakly cemented caliche about 20 inches thick. It is silty clay loam that is about 35 percent calcium carbonate. Below this, to a depth of 64 inches, is pink, massive silty clay loam that is about 12 percent calcium carbonate.

These soils are well drained. The available water capacity is high.

Representative profile of Reagan silty clay loam, 0 to 1 percent slopes, 5 miles east of the intersection of the paved county road and Salt Lake road; intersection is 19 miles south-southeast of the Midland city limits:

A11—0 to 1 inch, light brownish-gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) when moist; moderate, medium, platy structure; slightly hard, friable; calcareous; moderately alkaline; clear, smooth boundary.

A12—1 to 8 inches, light brownish-gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) when moist; moderate, medium, subangular blocky structure; hard, firm; common fine pores; common roots; calcareous; moderately alkaline; clear, smooth boundary.

B2—8 to 34 inches, light-brown (7.5YR 6/4) silty clay loam, dark brown (7.5YR 4/4) when moist; moderate, medium, subangular blocky structure; very hard, firm; common fine and medium pores; few worm casts; common roots; few very fine and fine fragments of calcium carbonate; calcareous: moderately alkaline; clear, wavy boundary.

C1ca—34 to 54 inches, pinkish-white (7.5YR 8/2) weakly cemented caliche of silty clay loam texture, pinkish gray (7.5 YR 7/2) when moist; massive (structureless); hard, friable; 35 percent is segregated concretions and soft masses of calcium carbonate; calcareous; moderately alkaline; gradual, wavy boundary.

C2—54 to 64 inches, pink (7.5YR 7/4) silty clay loam, brown (7.5YR 5/4) when moist; massive (structureless); hard, friable; 12 percent by volume is segregated calcium carbonate; calcareous; moderately alkaline.

The A horizon is 5 to 10 inches thick. The color ranges from light brownish gray to brown.

The B2 horizon is 15 to 30 inches thick. The color ranges from pale brown to brown.

The depth to the C1ca horizon is 20 to 40 inches. This horizon is 30 to 60 percent or more segregated calcium carbonate. This horizon is intermittently strongly to weakly cemented.

Reagan silty clay loam, 0 to 1 percent slopes (ReA).—This soil is on irregularly shaped to oval areas on smooth plains. These areas range from 20 to 2,000 acres in size but are dominantly about 400 acres. Soil surfaces are level or weakly concave.

Included in mapping were small areas of Lipan clay in depressions and Upton loam on convex slopes. Inclusions make up less than 20 percent of any given area.

Most of this soil is used for range, but some areas are used for dryland and irrigated crops. The hazard of soil blowing is slight to moderate. (Capability unit IIe-2, irrigated, and IVc-1, dryland; Deep Soil range site)

Reeves Series

The Reeves series consists of calcareous, moderately permeable soils that are shallow to moderately deep over gypsum. These soils developed in loamy sediments over beds of gypsum.

In a representative profile the surface layer is pale-brown loam about 7 inches thick. The next layer is very pale brown clay loam about 17 inches thick. Below this is very pale brown loam about 12 inches thick that contains gypsum crystals and soft masses of calcium carbonate. This is underlain by pinkish-white gypsum to a depth of 42 inches.

These soils are well drained. The available water capacity is moderate.

Representative profile of Reeves loam, 0 to 1 percent slopes, south of Monahans Draw and 1.35 miles east of the Ector-Midland County line marker; 6 miles west of the intersection of the paved county road with Farm Road 1788; intersection is 10 miles west and south of the Midland air terminal:

A1—0 to 7 inches, pale-brown (10YR 6/3) loam, dark brown (10YR 4/3) when moist; weak, very fine, subangular blocky structure; slightly hard, friable; few very fine and fine pores; common roots; calcareous; moderately alkaline; clear, smooth boundary.

B2—7 to 24 inches, very pale brown (10YR 7/3) clay loam, brown (10YR 5/3) when moist; weak, fine, subangular blocky structure; slightly hard, friable; few very fine pores; few roots; few films and threads of calcium carbonate; common crystals of gypsum; calcareous; moderately alkaline; clear, wavy boundary.

Ccacs—24 to 36 inches, very pale brown (10YR 8/3) loam, very pale brown (10YR 7/3) when moist; massive (structureless); many gypsum crystals; few soft masses of calcium carbonate; calcareous; moderately alkaline; gradual, wavy boundary.

R—36 to 42 inches, pinkish-white (7.5YR 8/2) gypsum, white (7.5YR 8/1) when moist; massive (structureless) has a hardness of about 2 on the Mohs scale; calcareous; moderately alkaline.

The A horizon ranges from 4 to 10 inches in thickness and from light brownish gray to very pale brown in color.

The B2 horizon ranges from light brownish gray to very pale brown in color and from loam to clay loam in texture.

The depth to the Ccacs horizon is 10 to 34 inches.

The depth to the R layer is 20 to 40 inches.

Reeves loam, 0 to 1 percent slopes (RvA).—This soil occupies irregular areas on uplands. These areas range from 10 to 600 acres in size but are dominantly about 200 acres. Soil surfaces are level to weakly convex.

Included in mapping were small areas of Gypsum land that make up less than 15 percent of any given area.

Most of this soil is used for range (fig. 9). A. few areas are cultivated to irrigated and dryland crops. The hazard of soil blowing is severe. (Capability unit IIIes-1, irrigated, and VIs-3, dryland; Deep Soil range site)

Sharvana Series

The Sharvana series consists of moderately permeable soils on uplands. These soils are shallow to indurated caliche. They developed in loamy materials underlain by beds of indurated caliche.

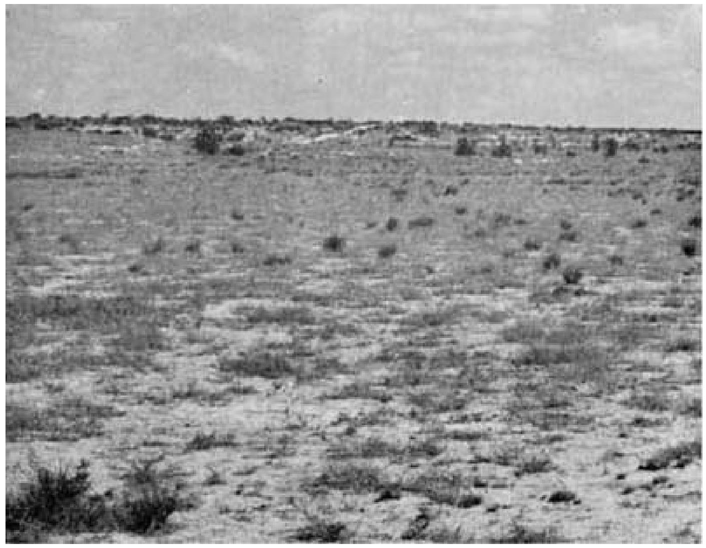

Figure 9.—Area of Reeves loam that shows typical range vegetation.

In a representative profile the surface layer is reddish brown fine sandy loam about 6 inches thick. The next layer is reddish-brown sandy clay loam about, 8 inches thick. This is underlain to a depth of 24 inches by indurated platy caliche that is laminar in the uppermost 2 inches.

These soils are well drained. The available water capacity is low.

Representative profile of Sharvana fine sandy loam, 0 to 3 percent slopes, in a native pasture 1.3 miles west of Greenwood School; 100 feet north and 8.6 miles east of the intersection of Texas Highway 459 and Farm Road 307 in Midland:

A1—0 to 6 inches, reddish-brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4) when moist; weak, fine, granular structure; hard, friable, slightly sticky; many fine roots; neutral; clear, smooth boundary.

B2t—6 to 14 inches, reddish-brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) when moist; moderate, coarse, prismatic structure breaking to weak, fine, subangular blocky; very hard, Friable, sticky and slightly plastic; few clay films on prism faces, slightly darker than crushed soil; neutral in the upper part, mildly alkaline in the lower part; abrupt, wavy boundary.

Ccam—14 to 24 inches, indurated platy caliche that is laminar in the upper 2 inches; the upper surfaces of the plates are smooth; the lower sides of the plates have small pendants of calcium carbonate up to 1 centimeter long.

The A horizon ranges from 4 to 8 inches in thickness. The color ranges from reddish brown to brown.

The B2t horizon ranges from 4 to 14 inches in thickness. The color ranges from reddish brown to red.

Caliche is at a depth of 8 to 20 inches. It ranges from indurated to strongly cemented.

Sharvana fine sandy loam, 0 to 3 percent slopes (SaB).—This soil occupies irregular areas on plains. These areas range from 20 to 200 acres in size. Soil surfaces are level to convex.

Small areas of Lipan clay and Kimbrough loam were included with this soil in mapping. Inclusions make up less than 15 percent of any given area.

This soil is used mostly for range, but a few areas are used for irrigated and dryland crops. The shallowness of time soil limits the total available water capacity. The hazard of soil blowing is moderate, and the hazard of water erosion is moderate on gently sloping areas. (Capability unit IIIe-10, irrigated, and IVe-10, dryland; Sandy Loam range site)

Simona Series

The Simona series consists of shallow, calcareous, moderately rapidly permeable soils on uplands. These soils developed in loamy sediments and are underlain by indurated caliche.

In a representative profile the surface layer is brown, calcareous fine sandy loam about 5 inches thick. The next layer is brown, friable fine sandy loam about 10 inches thick. This is underlain to a depth of 17 inches by strongly cemented platy caliche that is laminar in the upper part.

These soils are well drained. The available water capacity is low.

Representative profile of Simona fine sandy loam, 0 to 3 percent slopes, 4 miles southeast of the intersection of Texas Highway 158 with the Interstate 20 bypass:

A1—0 to 5 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) when moist; weak, very fine, subangular blocky structure; slightly hard, friable; many very fine to medium pores; few worm casts; many roots; calcareous; moderately alkaline; clear, smooth boundary.

B2—5 to 15 inches, brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/4) when moist; weak, fine, subangular blocky structure; slightly hard, friable; common very fine and fine pores; common roots; few fine to coarse caliche fragments; calcareous; moderately alkaline; abrupt, wavy boundary.

Ccam—15 to 17 inches, strongly cemented platy caliche; the upper part is laminar; plates are 4 to 8 inches in diameter and 1 to 2 inches thick and have small pendants of calcium carbonate on the lower sides.

The A1 horizon ranges from 4 to 10 inches in thickness. The color ranges from grayish brown to brown.

The B2 horizon ranges from grayish brown to brown.

The depth to the Ccam horizon is 12 to 20 inches. The upper part is indurated to strongly cemented. It becomes less cemented as depth increases.

Simona fine sandy loam, 0 to 3 percent slopes (SfB).—This soil is on plains. The areas are rounded to irregular in shape, and soil surfaces are level and convex. These areas range from 10 to 100 acres in size, but they are dominantly about 30 acres.

Small areas of Gomez fine sandy loam and Kimbrough loam were included with this soil in mapping. Inclusions make up less than 20 percent of any one area.

Most of this soil is in range, but a few small areas are used for dryland and irrigated crops. The hazard of soil blowing is moderate, and the hazard of water erosion is moderate for gently sloping areas. (Capability unit IIIe-10, irrigated, and IVe-10, dryland; Shallowland range site)

Slaughter Series

The Slaughter series consists of shallow moderately slowly permeable soils on uplands. These soils developed in loamy sediments over indurated platy caliche.

In a representative profile the surface layer is brown loam about 5 inches thick. The next layer is reddish-brown clay loam about 10 inches thick. The underlying material, to a depth of 24 inches, is platy caliche, which is indurated and laminar or banded in the uppermost 2 inches and strongly cemented in the lower part.

These soils are well drained. The available water capacity is low.

Representative profile of Slaughter loam, 0 to 1 percent slopes, 2.3 miles west of the intersection of Interstate Highway 20 and Farm Road 1788, west of the Midland Air Terminal; 0.15 mile north and 0.13 mile west of the southeast corner of sec. 2, block 41, Texas and Southern Pacific Railway 2 survey:

A1—0 to 5 inches, brown (7.5YR 4/3) loam, dark brown (7.5YR 3/3) when moist; moderate, fine, subangular blocky structure; hard, friable; many roots; mildly alkaline; gradual, smooth boundary.

B2t—5 to 15 inches, reddish-brown (5YR 4/3) clay loam, dark reddish brown (5YR 3/3) when moist; moderate, medium, blocky structure: very hard, friable; nearly continuous thin clay films; few fine roots; few fine pores; neutral; abrupt, wavy boundary.

Ccam—15 to 24 inches, platy caliche that is indurated and laminar or banded in the upper 2 inches and strongly cemented in the lower part; the plates are 3 to 8 inches thick and 10 to 24 inches across horizontally; the caliche plates are smooth on the upper surfaces and knobby or nodular beneath.

The A horizon is 4 to 8 inches thick. The color ranges from brown to reddish brown. Reaction ranges from neutral to moderately alkaline.

The B2t horizon is 5 to 12 inches thick. The color ranges from red to brown. The texture ranges from clay loam to clay.

The depth to the Ccam horizon is 9 to 20 inches. This horizon ranges from 6 inches to several feet in thickness. At least the uppermost half inch has a hardness of 3 to 5 on the Mohs scale**.**

Slaughter loam, 0 to 1 percent slopes (SlA).—This soil occupies smooth, rounded, or irregularly shaped areas on plains. These areas range from 20 to 400 acres in size but are dominantly about 120 acres. Soil surfaces are level and weakly concave.

Included in mapping were small, weakly convex areas of Kimbrough loam and Lipan clay in shallow depressions. Inclusions make up less than 20 percent of any given area.

This soil is used mostly for range. Shallowness causes it to be droughty, and there is a slight hazard of soil blowing. Runoff is slow. (Capability unit IVs-7, irrigated, and VIs-1, dryland; Deep Hardland range site)

Springer Series

The Springer series consists of deep, moderately rapidly permeable soils on uplands. These soils developed in loamy sediments.

In a representative profile the surface layer is brown to reddish-brown, loose loamy fine sand about 15 inches thick. The next layer is fine sandy loam that extends to a depth of 60 inches. It is yellowish red in the upper 30 inches and reddish yellow in the lower part.

The Springer soils are well drained. The available water capacity is moderate.

Representative profile of Springer loamy fine sand, 0 to 3 percent slopes, 200 feet south of the oilfield road and 150 feet east of Farm Road 1379; 1.5 miles south of Spraberry:

A11—0 to 4 inches, brown (7.5YR 5/4) loamy fine sand, dark brown (7.5YR 4/4) when moist; single grain (structureless); loose; common roots; neutral; clear, smooth boundary.

A12—4 to 15 inches, reddish-brown (5YR 5/4) loamy fine sand, reddish brown (5YR 4/4) when moist; single grain (structureless); loose; common roots; neutral; clear, smooth boundary.

B21t—15 to 45 inches, yellowish-red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) when moist: weak, very thick, prismatic structure breaking to weak, fine, subangular blocky; slightly hard, very friable; few thin clay films on sand grains; few roots; neutral; diffuse, smooth boundary.

B22t—45 to 60 inches, reddish-yellow (5YR (6/6) fine sandy loam, yellowish red (5YR 5/6) when moist; weak, very thick, prismatic structure; slightly hard, very friable; few clay films on sand grains; mildly alkaline.

The A horizon ranges from 10 to 20 inches in thickness. The color ranges from brown to reddish brown. The texture ranges from loamy fine sand to fine sandy loam.

The Bt horizon ranges from reddish brown to yellowish red. The structure ranges from subangular blocky to prismatic. Reaction ranges from neutral to moderately alkaline.

Springer fine sandy loam, 1 to 3 percent slopes (SnB).—This soil occupies irregularly shaped areas on plains. Those areas range from 10 to 90 acres in size but are dominantly about 35 acres. Soil surfaces are convex.

The surface layer is brown fine sandy loam about 12 inches thick. The next layer is fine sandy loam that extends to a depth of more than 60 inches. It is reddish brown in the upper 30 inches and reddish yellow in the lower part. Small areas of Sharvana fine sandy loam were included in mapping. They make up less than 10 percent of any given area.

This soil is used mostly for range, but a few areas are used for irrigated and dryland crops. The hazard of soil blowing is moderate, and the hazard of water erosion is slight. (Capability unit IIIe-7, irrigated, and IIIe-5, dryland; Sandy Loam range site)

Springer loamy fine sand, 0 to 3 percent slopes (SpB).—This soil occupies irregularly shaped areas on plains. These areas range from 30 to 500 acres in size, but they are dominantly about 200 acres. Soil surfaces are undulating. This soil has the profile described as representative for the series.

Small areas of Amarillo fine sandy loam and Tivoli fine sand were included in mapping. Inclusions make up less than 15 percent of any given area.

This soil is mostly used for range, but a few small areas are used for irrigated crops. The hazard of soil blowing is severe. Runoff is slow. (Capability unit IVe-5, irrigated, and VIe-5, dryland; Sandyland range site)

Stegall Series

The Stegall series consists of moderately deep, moderately slowly permeable soils on uplands. These soils developed in loamy sediments underlain by indurated platy caliche.

In a representative profile the surface layer is dark-brown, neutral loam about 10 inches thick. The next layer is reddish-brown clay loam about 20 inches thick. It is underlain to a depth of 34 inches by indurated platy caliche that is laminar in the upper part.

These soils are well drained. The available water capacity is high.

Representative profile of Stegall loam, 100 feet west of pasture oilfield road and 0.3 mile south of Interstate Highway 20; 8.5 miles east of the Midland courthouse:

A1—0 to 10 inches, dark-brown (7.5YR 4/3) loam, dark brown (7.5YR 3/3) when moist; moderate, medium, subangular blocky structure; hard, friable; common roots; neutral; clear, smooth boundary.

B2t—10 to 30 inches, reddish-brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) when moist; moderate, medium, blocky structure; very hard, firm; continuous thin clay films on ped faces; few fine pores; few roots; neutral; abrupt, wavy boundary.

Ccam—30 to 34 inches, indurated platy caliche; laminar in the upper ½ inch to 3 inches; plates are 3 to 8 inches thick and have pendants of strongly cemented calcium carbonate on the lower sides; cementation decreases as depth increases.

The A horizon is 8 to 12 inches thick. It ranges from brown to dark brown.

The B2t horizon ranges from brown to reddish brown.

The depth to platy caliche is 20 to 36 inches. The laminar part of the caliche has a hardness of 3 to 5 on the Mohs scale.

Stegall loam (St).—This soil occupies smooth, rounded to irregularly shaped areas on plains. These areas are dominantly about 40 acres in size. Soil surfaces are level and weakly concave, and the slope is less than 1 percent.

Included in mapping were small areas of Kimbrough loam, Slaughter loam, and Arvana fine sandy loam. Inclusions make up less than 20 percent of any given area.

This soil is mostly used for range. A few areas are cultivated to dryland and irrigated crops. The hazard of soil blowing is slight. Runoff is slow. (Capability unit IIe-2, irrigated, and IIIce-2, dryland; Deep Hardland range site)

Tivoli Series

The Tivoli series consists of deep, rapidly permeable soils on uplands. These soils developed in sandy sediments.

In a representative profile the surface layer is brown, loose fine sand about 8 inches thick. The underlying material is reddish-yellow, loose fine sand that extends to a depth of more than 60 inches.

The Tivoli soils are excessively drained.

Representative profile of Tivoli fine sand, 1.5 miles southwest of the intersection of the oilfield road with paved county road; intersection is 4.6 miles east of Texas Highway 158 and 6.6 miles southeast of the Midland city limits:

A11—0 to 3 inches, brown (10YR 5/3) fine sand, dark brown (10YR 4/3) when moist; single grain (structureless); loose; common roots; mildly alkaline; clear, smooth boundary.

A12—3 to 8 inches, brown (7.5YR 5/4) fine sand, dark brown (7.5YR 4/4) when moist; single grain (structureless); loose; few roots; neutral; clear, smooth boundary.

C—8 to 60 inches, reddish-yellow (5YR 6/6) fine sand, yellowish red (5YR 5/6) when moist; single grain (structureless); loose; few roots; neutral.

The A horizon is 4 to 10 inches thick. The color ranges from brown to light brown. Reaction is neutral to mildly alkaline.

The C horizon ranges from brown to yellowish red. Reaction is neutral to mildly alkaline.

Tivoli fine sand (Tf).—This soil occupies moon-shaped, stabilized dunes on uplands. Soil surfaces are convex and undulating, and the slope ranges from 1 to 5 percent.

Small areas of Springer loamy fine sand were included in mapping. They make up less than 15 percent of any given area.

This soil is used for range. The hazard of soil blowing is severe, and runoff is very slow. (Capability unit VIIe-1, dryland; Deep Sand range site)

Upton Series

The Upton series consists of shallow and very shallow, calcareous, moderately permeable soils on uplands. These soils developed in calcareous, loamy sediments over indurated caliche.

In a representative profile the surface layer is light brownish-gray, calcareous loam about 5 inches thick. The next layer is about 10 inches thick. It is about 90 percent light brownish-gray, friable clay loam and about 10 percent caliche rock fragments. This layer is underlain, to a depth of 20 inches, by whitish indurated platy caliche that is laminar in the upper part.

The Upton soils are well drained. The available water capacity is low.

Representative profile of Upton loam, 1 to 3 percent slopes, 0.05 mile southeast of the intersection of the pasture oilfield road with the paved county road; intersection is 1.35 miles east of the Rankin Highway and 22 miles south of the Midland courthouse:

A1—0 to 5 inches, light brownish-gray (10YR 6/2) loam, dark brown (10YR 4/3) when moist; weak, thin, platy structure in uppermost 1 inch and moderate, medium, subangular blocky structure in lower part; hard, friable; 5 percent, by volume, is caliche rock fragments $^{1}/_{8}$ to $^{1}/_{2}$ inch in diameter; calcareous; moderately alkaline; clear, smooth boundary.

B2—5 to 15 inches, light brownish-gray (10YR 6/2) clay loam, brown (10YR 5/3) when moist; moderate, medium, subangular blocky structure; hard, friable; 10 percent, by volume, is coarse caliche fragments; calcareous; moderately alkaline; abrupt, wavy boundary.

Ccam—15 to 20 inches, whitish platy caliche; laminar and indurated in uppermost $^{1}/_{2}$ inch to 3 inches; plates range from 3 to 8 inches in thickness and have pendants of strongly cemented calcium carbonate on the lower sides.

The A horizon ranges from 4 to 6 inches in thickness, from light brownish gray to brown in color, and from loam to gravelly loam in texture. The volume of caliche fragments ranges from 2 to 35 percent.

The B2 horizon ranges from light brownish gray to brown.

The depth to the Ccam horizon ranges from 6 to 20 inches. This horizon ranges from indurated in the upper laminar surface to weakly cemented below. The laminar part has a hardness of 3 to 4 on the Mohs scale. In most places this horizon is underlain by hard limestone at a depth of 2 to 12 feet.

Upton loam, 1 to 3 percent slopes (UpB).—This soil occupies large upland areas on ridges, divides, fans, and foot slopes, mostly along large and small drainageways (fig. 10). The soil surfaces are convex. This soil has the profile described as representative for the series.

Included in mapping were small, nearly level areas of Reagan silty clay loam. Also included were small, narrow concave areas of Bippus clay loam in drainageways and small areas of deeper soils. Inclusions make up less than 20 percent of any given area.

Because it is shallow, this soil is better suited to range than to other uses. Runoff is medium. (Capability unit VIs-2, dryland; Shallow Divide range site)

Upton-Reagan complex (Ur).—This complex consists of nearly level to gently sloping soils. It is about 55 percent Upton loam, 40 percent Reagan silty clay loam, and 5 percent other soils. The slope ranges from less than 1 percent to about 3 percent.

Figure 10.—Excavation for a pipeline in Upton loam.

Upton loam is nearly level to gently sloping. It is in irregularly shaped, convex areas 200 to 800 feet wide in their narrowest parts. The surface layer is light brownish-gray loam about 5 inches thick. The next layer is light brownish-gray clay loam, about 10 inches thick, that is about 10 percent caliche rock fragments. The underlying material is whitish platy caliche that is laminar in the upper part.

Reagan silty clay loam is nearly level. It occurs as weakly concave areas that are rounded in shape and 100 to 600 feet across. The surface layer is light brownish-gray, calcareous silty clay loam about 8 inches thick. The next layer is light-brown, subangular blocky silty clay loam about 26 inches thick. The next lower layer is pinkish-white, weakly cemented caliche of silty clay loam texture about 20 inches thick. This layer is about 15 percent calcium carbonate. The underlying material is pink, massive silty clay loam that is about 12 percent calcium carbonate.

Minor soils in this complex are Bippus clay loam, Kimbrough loam, Lipan clay, and Stegall loam.

This complex is used mostly for range, but a few small areas are used for irrigated crops. Surface runoff is medium. (Capability unit IVs-7, irrigated, and VIs-2, dryland; Shallow Divide range site)

Upton gravelly loam, very shallow (Ut).—This soil occupies oblong, narrow areas that range from 30 to 200 acres in size but are dominantly about 70 acres. Many cobblestones and fragments of caliche and limestone occur on the surface. The slope ranges from 1 to 8 percent. Slopes are convex.

The surface layer is light brownish-gray, calcareous gravelly loam about 6 inches thick. It is underlain by indurated platy caliche that is laminar in the upper few inches and is underlain by hard limestone.

Included in mapping were gently sloping areas of Upton loam, nearly level areas of Reagan silty clay loam, and small areas of limestone outcrops. Inclusions make up less than 15 percent of any given area.

Because this soil is very shallow, it is used only for range. Runoff is medium. (Capability unit VIIs-1, dryland; Shallow Divide range site)

Use and Management of the Soils

The first part of this section discusses the use and management of the soils for range. The second explains how soils are grouped according to their capability and briefly describes each capability unit and the general management practices for soils

in the unit. The predicted average yields per acre of cotton and grain sorghum are given for all the soils of the county. The use of the soils for wildlife is briefly discussed, and the last part of the section describes engineering uses of the soils.

Use of the Soils for Range

By Hershel M. Bell, range conservationist, Soil Conservation Service, Lubbock, Tex.

Midland County has approximately 480,000 acres of native grassland. Ranches in the county range from approximately 800 to 51,000 acres in size. Most have varying amounts of cropland used primarily for growing feed crops and supplemental forage.

Both cattle and sheep are run on ranges in the southern part of the county, but the rest of the county is used primarily for cow-calf operations. On two or three ranches, the range is used for grazing stocker calves during the winter but is not grazed in summer.

Range sites and condition classes

Soils differ in their potential to produce native plants. The soils that produce about the same kind and amount of climax, or original, vegetation in areas of range make up a specific range site.

Range sites differ in their capacity to produce various kinds or proportions of plant species or in the total annual yield. Significant differences require some variation in management, such as a different rate of stocking. The kinds, proportion, and amount of plants that different range sites can support depend mainly on the environmental factors of soil, topography, and climate.

Most native grasslands of Midland County have been heavily grazed for several generations, and their original plant cover has been altered. Range condition is the present state of vegetation on a range site in relation to its potential plant cover.

Four range condition classes are recognized. A range site is in excellent condition if 76 to 100 percent, by weight, of the present vegetation is of the same kind as the original, or potential, vegetation. It is in good condition if the percentage is between 51 and 75, in fair condition if the percentage is between 26 and 50, and in poor condition if the percentage is 25 or less.

The plants on any given range site are grouped, according to their response to grazing, as decreasers, increasers, and invaders.

Decreasers are species in the potential plant community that decrease in relative abundance if heavily grazed. Most of these plants are preferred by grazing animals. The total of all such species is counted in determining range condition class.

Increasers are species in the potential plant community that normally increase in relative abundance as the decreasers decline. Some increasers that are grazed at a moderately high rate may initially increase and then decrease as grazing pressure continues. Others may continue to increase, either in actual numbers or in relative proportion. Only the percentage of increaser plants normally expected in the potential plant community is counted in determining range condition.

Invaders are not members of the potential plant community for the site, but they invade the community after the climax vegetation has deteriorated. They may be annuals or perennials, grasses, weeds, or woody plants. Some have relatively high grazing value, but many are worthless. Invader plants are not counted in determining range condition class.

For most range sites and most range livestock operations, the higher the range condition class, the better the quality and the greater the amount of available forage.

Descriptions of range sites

The soils of Midland County have been grouped in 11 range sites, which are described in the following pages. The characteristics of each site are described, the

composition of the potential plant community is given, and the principal invaders are listed. Also given, for each range site, is the potential yield of forage in favorable and unfavorable years. A favorable year is one in which the total rainfall is normal or above; an unfavorable year is one in which the rainfall is below normal.

To find the range site in which each soil has been placed, refer to the "Guide to Mapping Units, (Removed)." Active dune land and Lipan clay have not been placed in a range site. The clayey soils at the bottoms of natural lakes or depressions are never large in extent and are, included in other mapping units. Active dunes usually are associated with the Deep Sand or Sandyland range sites. Where there are larger inclusions of Active dune land, adjustments are made in treatment and management.

Bottomland range site

The Bottomland range site occupies narrow draws in which water flows only during storm periods. Because the site receives runoff from upstream watersheds and adjacent soils, it has an excellent potential for good-quality range grasses. The soil is deep clay loam that has high available water capacity.

Good stands of mid grasses are produced on this site. If the site is in excellent condition, about 65 percent of the vegetation consists of side-oats grama, cane bluestem, silver bluestem, vine-mesquite, white tridens, and plains bristlegrass. Common increasers that make up about 35 percent, by weight, of the vegetation are blue grama, buffalograss, tobosagrass, prairie-clover, and Engelmann-daisy. Invaders are sand muhly, broom snakeweed, croton, lotebush, mesquite, and annuals.

Mesquite invasion results in serious deterioration of the site. As the brush increases, the better grasses decrease and become nearly extinct. This results in accelerated erosion and poor range condition.

This site recovers if brush is controlled by chemical or mechanical methods. Seeding is generally needed to supplement mechanical control of brush. Because of the hazard of occasional flooding, earthen structures for water conservation are generally unsatisfactory. Net wire spreaders may be used, however, to spread water over a wider area and to increase the water intake by holding water on the soil for a longer period.

If the site is in excellent condition, the total annual yield of air-dry herbage ranges from 1,500 to 3,000 pounds per acre, depending on variations in rainfall.

Deep Hardland range site

The Deep Hardland range site consists of nearly level, moderately fine textured and medium-textured soils on plains (fig. 11). In many places these soils are adjacent to sloping areas that provide runoff water for the site. The slope is 0 to 1 percent. Because these soils are deep to shallow clay loams and loams, the plant-soil-air-water relationship is fair to poor.

Plants on this range site have a comparatively low air and water requirement. If the site is in excellent condition, about 55 percent of the vegetation consists of blue grama, side-oats grama, cane bluestem, silver bluestem, Arizona cottontop, and vine-mesquite. Common increasers that make up about 45 percent by weight of the vegetation are buffalograss and tobosagrass. Invaders are three-awn, sand dropseed, burrograss, mesquite, pricklypear, and annuals.

This site recovers if brush is controlled by chemical or mechanical methods. Seeding generally is needed to re-store a stand of good-quality grasses, and this seeding is most suitable when the site is converted from cropland to rangeland. Water conservation practices are needed in most places. Where drought has seriously retarded vegetation, renovation of fields or chisel cultivation is feasible.

If the site is in excellent condition, the total annual yield of air-dry herbage ranges from 800 to 2,000 pounds per acre, depending on variations in rainfall.

Figure 11.—A Deep Hardland range site in good condition. The soil is Stegall loam.

Mixed Plains range site

The Mixed Plains range site consists of deep, nearly level to gently sloping fine sandy loams and loams on open plains.

If the site is in excellent condition, about 60 percent by weight of the vegetation consists of decreasers. These are side-oats grama, blue grama, cane bluestem, silver bluestem, and vine-mesquite. Common increasers that make up about 40 percent of the vegetation are black grama, sand dropseed, and perennial three-awn. Invaders are sand muhly, ring muhly, burrograss, mesquite, four-wing saltbush, and annuals.

Brush invasion is generally not severe on this site. Scattered areas of mesquite and scattered four-wing salt-bush respond to brush control. Seeding is a satisfactory supplement to mechanical control of brush. The site recovers rapidly under good management.

If the site is in excellent condition, the total annual yield of air-dry herbage ranges from 1,100 to 1,800 pounds per acre, depending on variations in rainfall.

Sandy Loam range site

The Sandy Loam range site occupies broad areas of nearly level to gently sloping fine sandy loams (fig. 12). Where it has deteriorated, this site consists of sparse stands of poor-quality grasses heavily infested with mesquite.

If the site is in excellent condition, it is dominated by decreasers that make up about 70 percent by weight of the vegetation. The decreasers are side-oats grama, blue grama, plains bristlegrass, cane bluestem, silver bluestem, and vine-mesquite. Common increasers that make up about 30 percent of the vegetation are black grama, sand drop-seed, hooded windmillgrass, and perennial three-awn invaders are sand muhly, mesquite, yucca, and annuals.

Where this site is in excellent condition, the wide variety of palatable and nutritious grasses provides a long and productive grazing season. Even where the site has deteriorated, forage plants continue to furnish good quality livestock feed. The site responds readily to brush control and to range seeding. Where a water supply is available, measures for the control and spreading of water are needed.

If the site is in excellent condition, the total annual yield of air-dry herbage ranges from 1,100 to 2,000 pounds per acre, depending on variations in rainfall.

Figure 12.—An area of the Sandy Loam range site. The soil is Amarillo fine sandy loam.

Sandyland range site

The Sandyland range site consists of nearly level to gently sloping and undulating loamy fine sands (fig. 13). Because of the topography and the sandy texture of the soil, there is little or no runoff. Invading woody species, such as mesquite, sand sagebrush, and yucca, increase as the range condition declines. Where not protected by vegetation, the site is susceptible to soil blowing.

Figure 13.—A Sandyland range site in poor condition. The soil is Springer loamy fine sand, 0 to 3 percent slopes.

If the site is in excellent condition, a wide variety of decreasers, such as little bluestem, side-oats grama, giant dropseed, cane bluestem, and silver bluestem, make up about 65 percent by weight of the vegetation. Increasers that make up about 35 percent of the vegetation are sand dropseed, perennial three-awn, fall witchgrass, hairy grama, and hooded windmillgrass. Invaders are mesquite, sand sagebrush, yucca, annual grasses, and forbs.

The site deteriorates rapidly, unless increasers and invaders are controlled. Chemical methods of control are effective against mesquite, sand sagebrush, and yucca.

If the site is in excellent condition, the total annual yield of air-dry herbage ranges from 1,200 to 2,500 pounds per acre, depending on variations in rainfall.

Deep Sand range site

The Deep Sand range site consists of deep fine sands that are undulating and duned. Permeability is rapid, and there is almost no runoff. The site is unstable in respect to both soil and vegetation. Although it supports a wide variety of plants, it deteriorates rapidly.

If the site is in excellent condition, decreasers make up about 60 percent by weight of the vegetation. They are sand bluestem, giant dropseed, Havard panicum, little bluestem, cane bluestem, and silver bluestem. Common increasers that make up about 40 percent of the plant community are sand dropseed, perennial three-awn, sand paspalum, fall witchgrass, and Havard oak. Annuals are common invaders.

The site responds to the control of Havard oak. The control of any vegetation on this site needs to be considered carefully, however, because the soils are highly susceptible to blowing. The site responds fairly well to seeding where a usable grass cover needs to be established.

If the site is in excellent condition, the total annual yield of air-dry herbage ranges from 1,400 to 2,800 pounds per acre, depending on variations in rainfall.

Shallowland (gravelly) range site

The Shallowland (gravelly) range site consists of very shallow gravelly loams in well-defined draws. On the sides of the draws soils have slopes of as much as 30 percent, but as the soil areas extend away from the draws, slopes are as gentle as 1 to 3 percent. Because of its position on the landscape, this site serves as a watershed for the draws and for the Bottomland range site. The available water capacity is low.

The site produces sparse stands of grasses that have little value for forage. If the site is in excellent condition, decreasers make up about 60 percent by weight of the vegetation. They are side-oats grama, black grama, cane and silver bluestem, plains bristlegrass, and blue grama. Common increasers that make up 40 percent of the vegetation are sand dropseed, slim tridens, and perennial three-awn. Invaders are hairy tridens, fluffgrass, broom snakeweed, mesquite, and annuals.

As this site deteriorates, there is neither an encroachment of increasers nor an invasion of other plants. Only a moderate number of woody plants will grow on this site. Response to chemical control of mesquite is good. Seeding is not likely to succeed, because the soil is too shallow. Good management is needed.

If the site is in excellent condition, the total annual yield of air-dry herbage ranges from 500 to 1,250 pounds per acre, depending on variations in rainfall.

Shallowland range site

The Shallowland range site consists of nearly level to gently sloping, shallow and very shallow soils on broad uplands (fig. 14). The slope ranges from 0 to 3 percent. These soils generally have a good plant-soil-air-moisture relationship.

This range site is less productive than other sites on uplands, but the forage is of high quality. If the site is in excellent condition, decreasers make up about 35 percent by weight of the vegetation. These are side-oats grama, plains bristlegrass, Arizona cottontop, blue grama, cane bluestem, and silver bluestem. Common increasers that make up about 65 percent of the vegetation are black grama, slim tridens, perennial three-awn, and hairy grama. Invaders are mesquite, broom snakeweed, and annuals.

Figure 14.—Livestock grazing on Shallowland range site. The soil is Kimbrough loam.

As the site begins to decline, it has sparse stands of the grama grasses, slim tridens, and three-awn. As deterioration continues, the dominant forage plants are slim tridens and three-awn, with broom snakeweed and mesquite encroaching. The site responds to control of mesquite by either mechanical or chemical methods. Good range management is effective over long periods of time.

If the site is in excellent condition, the total annual yield of air-dry herbage ranges from 750 to 1,500 pounds per acre.

Shallow Divide range site

The Shallow Divide range site consists of very shallow to deep, nearly level to sloping soils in valleys and on bottom lands. This site produces sparse stands of mid and short grasses.

If the site is in excellent condition, decreasers make up about 60 percent by weight of the vegetation. The decreasers are side-oats grama, cane and silver bluestem, plains bristlegrass, green sprangletop, blue grama, vine-mesquite, Arizona cottontop, and black grama. Common increasers that make up about 40 percent of the vegetation are slim tridens, tobosagrass, perennial three-awn, buffalograss, and burrograss. Invaders are mesquite, creosotebush, javelinabrush, redberry juniper, and annuals.

Where the site is grazed heavily, range condition declines at a rapid and consistent rate. The decline is caused by selective grazing of the most palatable and nutritious plants. It can be averted by a program of deferred grazing that includes all seasons of the year over a period of years.

This site recovers if brush is controlled. Mechanical methods are effective in controlling all species of brush, but chemical methods are better for controlling mesquite alone. The range is generally seeded to supplement mechanical brush control by scattering seed in disturbed areas. Side-oats grama, green sprangletop, and plains bristlegrass are suitable for this treatment.

If the site is in excellent condition, the total annual yield of air-dry herbage ranges from 1,000 to 2,400 pounds per acre, depending on variations in rainfall.

Deep Soil range site

The Deep Soil range site consists of shallow to deep, nearly level loams and silty clay loams on broad areas. Because of its position on the landscape, this site is generally grazed excessively. Livestock spend a greater percentage of time here than on the rougher upland sites.

If this site is in excellent condition, decreasers make up about 60 percent by weight of the vegetation. Decreasers are cane and silver bluestem, side-oats grama, plains bristlegrass, Arizona cottontop, and blue grama. Common increasers that make up about 40 percent of the vegetation are buffalograss, tobosagrass, sand dropseed, perennial three-awn, black grama, and burrograss. Invaders are mesquite, tarbush, condalia, red grama, and annuals.

Brush control is effective on this site. It can be done either by mechanical or chemical methods. Range seeding can be done in conjunction with mechanical brush control. Seeding grass without first clearing the brush is less effective, because the brushy vegetation uses up what little moisture is in the soil.

If the site is in excellent condition, the total annual yield of air-dry herbage ranges from 1,100 to 2,200 pounds per acre, depending on variations in rainfall.

Gyp range site

The Gyp range site consists of soils that range from a mere crust up to 20 inches in thickness. Areas of these soils are not extensive. They are highly susceptible to water erosion and soil blowing.

Although this site supports good quality grasses, overall forage production is low. If the site is in excellent condition, decreasers make up about 75 percent by weight of the vegetation. Decreasers are side-oats grama, blue grama, sacaton, and chino grama. Common increasers that make up 25 percent of the plants are alkali sacaton, and dropseed, perennial three-awn, gypgrass, and burrograss. Invaders are fourwing saltbush, halfshrub sundrop, pickleweed, dogweed, and annuals.

Good grazing management is needed on this site. Plants grown on these soils are seasonally palatable, and the favored grazing period for domestic livestock is early in spring. Fencing is desirable, but the extent and location of this site generally makes it impractical.

If the site is in excellent condition, the total annual yield of air-dry herbage ranges from 400 to 800 pounds per acre, depending on variations in rainfall.

Capability Grouping

Capability grouping shows, in a general way, the suit-ability of soils for most kinds of field crops. The groups are made according to the limitations of the soils when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive land-forming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitation of groups of soils for range, for forest trees, or for engineering.

In the capability system, all kinds of soils are grouped at three levels: the capability class, subclass, and unit. These are discussed in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use. No class I soils are in Midland County.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wild-life habitat. No class V soils are in Midland County.

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife habitat.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife habitat.

Class VIII soils and landforms have limitations that preclude their use for commercial plant production and restrict their use to areas of recreation, wildlife habitat, or water supply, or to esthetic purposes.

Capability subclasses are soil groups within one class; they are designated by adding a small letter, *e, w, s,* or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

Capability units are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe–4 or IIIe-6. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

In the following pages the capability units in Midland County are described, and suggestions for the use and management of the soils are given. To find the names of the soils in any given unit, refer to the "Guide to Mapping Units, (Removed)."

Management by capability units

By George K. Desha, agronomist, Soil Conservation Service

In the following pages the irrigated and dryland capability units of Midland County are described, and suggestions for the use and management of the soils are given.

Tame pasture makes up only a small percentage of the total acreage of the county. Where the soil is used for irrigated pasture, good management includes the control of grazing, as well as proper use of fertilizer and of irrigation water.

Capability unit IIe-2, Irrigated

This unit consists of deep and moderately deep, medium-textured and moderately fine textured soils that are nearly level. The surface layer is clay loam, loam, or silty clay loam, and the lower layers are clay loam or silty clay loam. The hazard of soil blowing is slight to moderate.

Cotton and grain sorghum are the main crops (fig. 15). Small acreages are used for bermudagrass, small grains, alfalfa, and forage sorghum.

Figure 15.—Irrigated cotton on Abilene clay loam.

Maintaining or improving productivity and tilth, controlling soil blowing, and properly managing irrigation water are the main objectives of management. Large amounts of crop residue from legumes and other cover crops are needed to maintain good tilth, and applications of commercial fertilizer are beneficial. Where irrigated pastures are grown, control of grazing is necessary. An irrigation system that supplies water without waste or hazard of erosion is needed.

Capability unit IIe-3, Irrigated

The only soil in this unit is Portales loam, 0 to 1 percent slopes. This deep, calcareous, moderately permeable soil is on smooth upland plains. The surface layer is loam, and the lower layer is clay loam. The available water capacity is high. The hazard of soil blowing is moderate.

Cotton and sorghum are the main crops. Small acreages are used for bermudagrass.

The main objectives of management are to maintain or improve soil productivity and tilth, to conserve moisture, and to control soil blowing.

Where this soil is used for crops, large amounts of residue are needed to maintain good tilth. Legumes and other cover crops, sorghum, and small grains included in the cropping system help supply this need. Crop residue left on the surface until time for preplanting irrigation helps control soil blowing. Additions of commercial fertilizer are beneficial. An irrigation system that permits irrigation without waste or water erosion is needed.

Capability unit IIe-4, Irrigated

This unit consists of nearly level, deep and moderately deep, moderately permeable soils on uplands. The surface layer is fine sandy loam, and the lower layers are sandy clay loam. The available water capacity is moderate to high. The hazard of soil blowing is moderate.

Cotton and sorghum are the main crops. Small acreages of alfalfa, bermudagrass, and small grains are also grown.

The main management objectives are to maintain and improve soil productivity and tilth and to control soil blowing. Large amounts of residue are needed to maintain gold tilth. Legumes and other cover crops or sorghum and small grains help supply this residue. If the residue is kept on the surface, it helps to control soil blowing.

Applications of commercial fertilizer are beneficial. An irrigation system that supplies water without waste or water erosion is needed.

Capability unit IIe-5, Irrigated

This unit consists of nearly level, deep, calcareous soils on smooth upland plains. The surface layer is fine sandy loam, and the lower layers are fine sandy loam to sandy clay loam. Permeability is moderate to moderately rapid, and the available water capacity is moderate to high. The hazard of soil blowing is moderate.

Cotton and grain sorghum are the main crops. Small acreages are used for bermudagrass, alfalfa, and forage sorghum.

The main management objectives are to control soil blowing, to maintain or improve soil productivity and tilth, and to manage irrigation water. Large amounts of crop residue are needed to maintain good tilth. Legumes and other cover crops help supply this residue, as does a cropping system that includes sorghum and small grains. If the residue is left on the surface, it helps control soil blowing. Applications of commercial fertilizer are also beneficial. An irrigation system that supplies water without waste or hazard of erosion is needed.

Capability unit IIIe-3, Irrigated

This unit consists of gently sloping, deep and moderately deep, moderately permeable soils on uplands. The surface layer is fine sandy loam, and the lower layers are sandy clay loam. The available water capacity is high to moderate. There is a moderate hazard of soil blowing and water erosion.

Cotton and grain sorghum are the main crops. Small acreages of small grains, bermudagrass, and forage sorghum are grown (fig.16).

Figure 16.—Livestock grazing irrigated bermudagrass on Amarillo fine sandy loam, 1 to 3 percent slopes.

The main objectives of management are to control water erosion and soil blowing, to maintain or improve soil productivity and tilth, and to manage irrigation water. Crop residue left on the surface helps control water erosion and soil blowing. Large amounts of residue are also needed to maintain good tilth. Legumes and other cover crops supply residue, as does the use of sorghum and small grains in the cropping

system. Applications of commercial fertilizer are beneficial. An irrigation system that supplies water without waste or water erosion is needed.

Capability unit IIIe-6, Irrigated

This unit consists of gently sloping, deep, moderately to moderately rapidly permeable soils on uplands. The surface layer is fine sandy loam, and the lower layers are fine sandy loam or sandy clay loam. The available water capacity is moderate to high. These soils are subject to moderate soil blowing and a slight hazard of water erosion.

Cotton and grain sorghum are the main crops. Small acreages of bermudagrass, alfalfa, and small grains are grown.

The main management objectives are to control soil blowing and water erosion, to manage irrigation water, and to maintain or improve soil productivity and tilth. Crop residue will help control soil blowing and water erosion if left on the surface until time for preplanting irrigation. An irrigation system is needed that will supply water without waste or water erosion. Large amounts of residue from legumes and other cover crops are needed to maintain good tilth. A suitable cropping system is one that includes sorghum and small grains, crops that produce a large amount of residue. Applications of commercial fertilizer are beneficial.

Capability unit IIIe-7, Irrigated

Springer fine sandy loam, 1 to 3 percent slopes, is the only soil in this unit. This deep, moderately rapidly permeable soil is on uplands. The surface layer is fine sandy loam and the lower layers are fine sandy loam. The available water capacity is moderate. This soil is subject to a moderate hazard of soil blowing and a slight hazard of water erosion.

Cotton and grain sorghum are the main crops. Small acreages of alfalfa, bermudagrass, and forage sorghum are grown.

The main management objectives are to control soil blowing and water erosion, to manage irrigation water, and to maintain or improve soil productivity and tilth. Crop residue left on the surface will help control soil blowing and water erosion. An irrigation system that supplies water without waste or water erosion is needed. The soil is kept in tilth by returning crop residue to the surface. A suitable cropping system is one that includes sorghum and small grains, crops that supply large amounts of residue. Legumes and other cover crops also supply residue. Additions of fertilizer are needed.

Capability unit IIIe-8, Irrigated

This unit consists of nearly level to gently sloping, deep, moderately to moderately rapidly permeable soils on uplands. The surface layer is loamy fine sand, and the lower layers are sandy clay loam to fine sandy loam. The available water capacity is moderate. The hazard of soil blowing is severe.

Cotton, grain sorghum, and bermudagrass are the main crops. Small acreages of alfalfa and forage sorghum are grown.

The main management objectives are to control soil blowing, to manage irrigation water, and to maintain or improve soil productivity and tilth. Crop residue left on the surface will help to control soil blowing. An irrigation system that supplies water without waste or water erosion is needed. Large amounts of crop residue are needed to maintain tilth. Legumes and other cover crops help supply residue. A suitable cropping system includes sorghum and small grains, crops that supply a large amount of residue. Applications of commercial fertilizer are also beneficial.

Capability unit IIIe-10, Irrigated

This unit consists of nearly level to gently sloping, shallow, moderately permeable to moderately rapidly permeable soils on uplands. The surface layer is fine sandy loam, and the lower layers are fine sandy loam to sandy clay loam. The available water capacity is low. The hazards of soil blowing and water erosion are moderate.

Cotton and grain sorghum are the main crops. Small acreages of these soils are used for bermudagrass, small grains, forage sorghum, and alfalfa.

The main objectives of management are to control soil blowing and water erosion, to manage irrigation water, to maintain or improve soil productivity and tilth, and to use a cropping system suited to the soil limitations.

Crop residue left on the surface helps control soil blowing and water erosion. An irrigation system that supplies water without waste or water erosion is needed. Large amounts of crop residue are needed to maintain good tilth. Legumes and other cover crops help supply residue. A suitable cropping system includes crops that supply a large amount of residue, such as sorghum and small grains. Applications of commercial fertilizer are beneficial.

Capability unit IIIes-1, Irrigated

Reeves loam, 0 to 1 percent slopes, is the only soil in this unit. It is a moderately deep to shallow, calcareous, moderately permeable soil on uplands. The surface layer is loam, and the lower layers are clay loam. The available water capacity is high. There is a severe hazard of soil blowing. Because it has a high content of lime, this soil is droughty and its use for farming is limited.

A few small areas of this soil are farmed, and the main crops are cotton and grain sorghum. Small acreages are used for bermudagrass, small grains, and alfalfa.

The main management objectives are to control soil blowing, to manage irrigation water, to maintain or improve soil productivity and tilth, and to use a cropping system suited to the soil limitations. Leaving crop residue on the surface until time to irrigate helps control soil blowing. An irrigation system that supplies water without waste or water erosion is needed. Tilth is maintained by returning large amounts of crop residue to the soil. Legumes and other cover crops supply residue, as do sorghum and small grains included in the cropping system. Applications of commercial fertilizer are beneficial.

Capability unit IVe-5, Irrigated

Springer loamy fine sand, 0 to 3 percent slopes, is the only soil in this unit. It is a deep, moderately rapidly permeable soil on uplands. The surface layer is loamy fine sand, and the lower layers are fine sandy loam. The available water capacity is moderate. There is a severe hazard of soil blowing.

A few small areas are irrigated and used for cotton, sorghum, small grains, and bermudagrass.

The main management objectives are to control soil blowing, to manage irrigation water, to maintain or improve soil productivity and tilth, and to use a cropping system suited to the soil limitations. Large amounts of crop residue should be kept on the surface to control soil blowing. A good irrigation system supplies water without waste or water erosion. A good cropping system consists mainly of crops that produce a large amount of residue, such as sorghum and small grains. Applications of fertilizer are needed.

Capability unit IVs-7, Irrigated

This unit consists of nearly level to gently sloping, shallow to deep, calcareous soils on uplands. Shallowness is a limitation for farming. Permeability is moderate to moderately slow. The hazard of soil blowing is slight to moderate.

A few areas of these soils are used for irrigated cotton and sorghum.

The main management objectives are to control soil blowing, to manage irrigation water, and to maintain or improve soil productivity and tilth. Large amounts of crop residue are returned to the surface to control soil blowing. A good irrigation system supplies water without waste or water erosion. A suitable cropping system consists mainly of high-residue crops such as sorghum and small grains. Applications of fertilizer are needed.

Capability unit IIIe-4, Dryland

This unit consists of nearly level to gently sloping, deep and moderately deep, moderately permeable soils on uplands. The surface layer is fine sandy loam, and the lower layers are sandy clay loam. The available water capacity is high to moderate. These soils are subject to moderate soil blowing.

Many areas of these soils are cultivated, and the rest are in range. Cotton and grain sorghum are the main crops, and small acreages are used for small grains and forage sorghum.

The main objectives of management are to maintain and improve soil productivity and tilth, to conserve moisture, and to control soil blowing and water erosion. Suitable cropping systems include high-residue crops. Terracing and contour farming are used to conserve moisture, and, in places, grassed waterways and diversion terraces are needed. Crop residue is returned to the surface to control soil blowing, and emergency tillage is helpful when residue is lacking.

Capability unit IIIe-5, Dryland

Springer fine sandy loam, 1 to 3 percent slopes, is the only soil in this unit. It is a deed, moderately rapidly permeable soil on uplands. The surface layer is fine sandy loam, and the lower layers are also fine sandy loam. The available water capacity is moderate. There is a moderate hazard of soil blowing and a slight hazard of water erosion.

A few areas of this soil are cultivated, but most are in range. Cotton and grain sorghum are the main crops, but small acreages are used for forage sorghum.

The main management objectives are to control soil blowing and water erosion and to maintain soil productivity and tilth. Suitable cropping systems include crops that furnish a large amount of residue. If residue is kept on the surface during the critical windy season, it helps to control soil blowing. Emergency tillage can be used to control soil blowing if crop residue is lacking.

Capability unit IIIe-6, Dryland

This unit consists of nearly level to gently sloping, deep, moderately permeable to moderately rapidly permeable soils on uplands. The surface layer is fine sandy loam, and the lower layers are fine sandy loam or sandy clay loam. The hazard of soil blowing is moderate, and there is a slight hazard of water erosion on gently sloping soils.

Some areas of these soils are cultivated, but most are in range. Grain sorghum and cotton are the principal crops (fig. 17).

The main management objectives are to control soil blowing and water erosion, to conserve moisture, and to maintain or improve soil productivity and tilth. A good management practice is to include high-residue crops in the cropping system. If residue is kept on the surface during the critical windy period, it helps to control soil blowing. Emergency tillage helps retard soil blowing if crop residue is lacking. Terracing and contour farming help conserve moisture and control water erosion on sloping soils. In some places grassed waterways and diversion terraces are needed.

Figure 17.—Bundled sorghum on Midessa fine sandy loam.

Capability unit IIIce-2, Dryland

This unit consists of nearly level, deep and moderately deep soils that are moderately to moderately slowly permeable. The surface layer is clay loam or loam, and the lower layers are clay loam. The available water capacity is high. These soils are subject to slight soil blowing.

These soils are well suited to small grains, sorghum, grasses, and cotton.

The main management objectives are to maintain or improve soil productivity and tilth, to conserve moisture, and to control soil blowing. Suitable cropping, systems include crops that provide large amounts of residue, such as small grains and sorghum. If the residue is kept on the surface during critical windy periods, it helps to control soil blowing. Where crop residue is lacking, emergency tillage helps to control soil blowing. Terracing and contour farming are desirable practices to conserve moisture. In some places grassed waterways and diversion terraces are needed.

Capability unit IIIce-3, Dryland

This unit consists of Portales loam, 0 to 1 percent slopes, a deep, calcareous, moderately permeable soil. This soil is on smooth, upland plains. The surface layer is loam, and the lower layers are clay loam. This soil is subject to moderate soil blowing. The available water capacity is high.

Some areas of this soil are cultivated, but many are left in range. Cotton and grain sorghum are the principal crops. Small acreages are used for grasses and small grains.

Maintaining or improving productivity and tilth, conserving moisture, and controlling soil blowing are the main objectives in managing this soil. To maintain tilth and control soil blowing, cropping systems should include grain sorghum, grass, small grains, or other crops that can be kept on the surface during the critical windy periods. Terracing and contour farming are used to conserve rainfall. Grassed waterways and diversion terraces are needed in some places. If crop residue is lacking, emergency tillage can be used to control soil blowing.

Capability unit IVe-7, Dryland

This must consists of nearly level to gently sloping, deep, moderately to moderately rapidly permeable, sandy soils on uplands. The surface layer is loamy fine sand, and the lower layers are sandy clay loam or fine sandy loam. The hazard of soil blowing is severe.

A few areas of these soils are cultivated, but most of them are in range. Small acreages are used for cotton, sorghum, and small grains.

The main management objectives are to control soil blowing and to maintain soil productivity and tilth. A good management practice is to include high-residue crops in the cropping system. If the residue is kept on the surface during critical windy periods, it helps to control soil blowing. If there is not enough crop residue, emergency tillage can be used to retard soil blowing. Grassed waterways and diversion terraces are needed in places.

Capability unit IVe-10, Dryland

This unit consists of nearly level to gently sloping, shallow, moderately to moderately rapidly permeable soils on uplands. The surface layer is fine sandy loam, and the lower layers are sandy clay loam or fine sandy loam. The hazard of soil blowing is moderate, and the water erosion hazard is moderate on gently sloping soils.

A few areas are cultivated, but these soils are mostly used for range. Cotton and grain sorghum are the principal crops. Small acreages are used for forage sorghum and small grains.

The main management objectives are to control soil blowing and water erosion, to conserve moisture, to maintain and improve soil productivity and tilth, and to use a cropping system suited to the soil limitations. A good management practice is to include high-residue crops in the cropping system. If the residue is kept on the surface during critical periods, it helps control soil blowing and erosion. Emergency tillage is needed if residue is lacking.

Capability unit IVc-1, Dryland

Only Reagan silty clay loam, 0 to 1 percent slopes, is in this unit. This deep, moderately permeable soil is on uplands. The surface layer is silty clay loam, and the lower layers are silty clay loam. The hazard of soil blowing is slight to moderate.

A few areas of this soil are cultivated, but most of them are in range. Small grains and sorghum are the principal crops.

The main management objectives are to conserve moisture and to improve and maintain soil productivity and tilth. A good management practice is to include high-residue crops in the cropping system. If residue is returned to the surface, it helps conserve moisture and control soil blowing. Terracing and contour farming are practices that help conserve rainfall.

Capability unit VIe-5, Dryland

The only soil in this unit is Springer loamy fine sand, 0 to 3 percent slopes. This deep, moderately rapidly permeable soil is on uplands. The surface layer is loamy fine sand, and the lower layers are fine sandy loam. The hazard of soil blowing is severe.

This soil is not suitable for dryland farming.

Capability unit VIw-1, Dryland

The only soil in this unit is Lipan clay, a deep and very slowly permeable soil. The surface layer and lower layers are clay throughout. This soil is subject to periodic flooding by runoff water from adjacent soils.

This soil is generally not suited to crops.

Capability unit VIs-1, Dryland

Only Slaughter loam, 0 to 1 percent slopes, is in this unit. This shallow, moderately slowly permeable soil is on uplands. The surface layer is loam, and the lower layer is clay loam. The hazard of soil blowing is slight.

This soil is mostly used for range. A few small areas are cultivated.

Capability unit VIs-2, Dryland

This unit consists of nearly level to gently sloping, shallow to deep, moderately permeable soils on uplands. The surface layer is silty clay loam, and the lower layers are loam to silty clay loam. These soils are subject to a slight to moderate hazard of soil blowing. In most areas the shallowness of these soils is a limitation to farming.

These soils are mostly used for range. A few small areas of the deeper soils are cultivated.

Capability unit VIs-3, Dryland

The only soil in this unit is Reeves loam, 0 to 1 percent slopes. This shallow to moderately deep, calcareous, moderately permeable soil is on uplands. The surface layer is loam, and the lower layers are clay loam. This soil is subject to a severe hazard of soil blowing.

This soil is mostly used for range, but a few areas are cultivated.

Capability unit VIIe-1, Dryland

The only soil in this unit is Tivoli fine sand. This deep, rapidly permeable, nearly level to undulating soil is in duned areas. The fine sand extends to a depth of several feet. The available water capacity is low, and the hazard of soil blowing is severe.

This soil is mainly suited to range.

Capability unit VIIs-1, Dryland

This unit consists of nearly level to steep, very shallow to shallow, moderately permeable to moderately slowly permeable soils on uplands. The gravelly loam to clay loam surface layer overlies fractured to indurated platy caliche. These soils are subject to soil blowing and water erosion.

These soils are suited mainly to range.

Capability unit VIIs-3, Dryland

Only Gypsum land is in this unit. This land type consists of outcrops of white gypsum that have little or no soil over the gypsum. These areas are gently sloping to moderately steep. They are subject to soil blowing and water erosion.

This land type is not suitable for cultivation. Most areas are used for range and support sparse stands of vegetation.

Capability unit VIIIe-1, Dryland

Only Active dune land is in this unit. This land type consists of miscellaneous dunes and ridges of accumulated sand and blown-out areas. It is severely eroded and supports almost no vegetation.

Predicted Yields

Table 2 shows the predicted average yields per acre of principal crops grown under a high level of management on dryland and irrigated soils. Crop yields over a period of years reflect the management of soil. Generally, continued high yields are a result of good management and an indication that the soil has been improved or is being kept in good condition.

Under a high level of management, the following practices are used on dryland:

1. Moisture is saved.
2. Crop residue is used to control soil blowing and water erosion.
3. Soil fertility is improved, and high-residue crops are grown regularly in the cropping system.
4. Soil tillage is timely and held to a minimum.
5. Improved methods of farming and improved crop varieties are used to increase crop production.

Under a high level of management, the following practices are used on irrigated soils:

1. A conservation irrigation system is used to make the best use of all rainfall and to supply water according to crop needs.
2. Fertilizer is used in amounts determined by soil tests and crop needs.
3. Crop residue is used to help control soil blowing and water erosion.
4. Crops are included in the cropping system to protect and improve the soil.
5. Improved methods of farming and improved crop varieties are used to increase crop production.

Wildlife

Most of the nearly level to gently sloping upland soils in Midland County are suited to, and support, one or more species of wildlife. About 76 percent of the acreage remains in native grassland, about 11 percent is cultivated, and about 13 percent is used for urban development.

Early settlers in the county found an abundance of antelope, buffalo, prairie chicken, and quail. The buffalo were exterminated by hunters about the time the county was settled. After the county was settled and livestock were introduced, overgrazing, fencing, and cultivation of the soil reduced the numbers of antelope, deer, squirrel, turkey, and prairie chicken. Prairie dogs, once numerous, are now almost extinct.

In recent years, people have begun to realize how much wildlife contributes to the economy. In spite of the loss of some species, Midland County has a moderate potential for the development of wildlife habitat, or recreational areas, or hunting and fishing. A large number of quail, doves, songbirds, small animals, and predators still inhabit the county.

The soils of the county have been placed in three wildlife sites, which are made up of one or more soil associations. The soil associations are shown on the general soil map at the back of this survey and are described in the section "General Soil Map." Each wildlife site is unique in topography, productivity, kinds and amounts of vegetation, and principal species of wildlife that inhabit the site.

Wildlife Site 1

This site consists of the Amarillo-Arvana-Midessa soil association. The soils of this association are deep and moderately deep and nearly level to gently sloping. About 70 percent of the acreage is in range. The native vegetation consists mainly of such short grasses as buffalograss, blue grama, and side-oats grama, and of associated legumes and forbs. The principal kinds of wildlife on this site are antelope, badger, coyote, and rabbit. Among the birds are doves, ducks, geese, quail, and songbirds.

Wildlife Site 2

This site consists of the Kimbrough-Slaughter, Reeves-Gypsum land, Bippus-Potter, Upton, and Reagan-Upton soil associations. These are very shallow to deep and nearly level to steep soils. Most of the acreage is used for range. The native vegetation consists of short to tall grasses, mainly buffalograss, blue grama, side-oats grama, little bluestem, sand bluestem, switchgrass, and indiangrass. A few scattered trees, such as mesquite, grow on the soils of the upland, and some redberry juniper grows on the steeper areas.

Antelope, deer, bobcat, rabbit, coyote, and skunk inhabit this site. The main kinds of birds are turkeys, doves, quail, prairie chicken, ducks, geese, and songbirds.

Wildlife Site 3

This site consists of the Springer-Miles and Tivoli-Springer soil associations. These are deep, nearly level to duned and undulating soils. Most of the acreage is in

range. The native vegetation is mainly mid and tall grasses, such as sand bluestem, little bluestem, cane and silver bluestem, and Havard panicum. Havard oak grows on the uplands. Rabbit, bobcat, and coyote are the principal animals on this site. Among the birds are quail, doves, prairie chicken, and songbirds.

Engineering Uses of the Soils

Prepared by Beade O. Northcut, Soil Conservation Service, Big Spring, Texas.

Some soil properties are of special interest to engineers because they affect the construction and maintenance of roads, airports, pipelines, facilities for water storage, erosion control structures, drainage systems, irrigation systems, and sewage disposal systems. Among the properties most important to the engineer are permeability to water, shear strength compaction characteristics, soil drainage, shrink-swell characteristics, grain size, plasticity, and reaction. The depth to the water table and to bedrock, the topography, and the hydrologic characteristics are also important.

The interpretations given in this section will be helpful to readers who are interested in the general characteristics of the soils. Engineers and those in related work will be interested in the tabular data.

With the use of the soil map for identification, the engineering interpretations reported here can be used for many purposes. It should be emphasized, however, that these interpretations do not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads and where the excavations are deeper than the depths of the layers here reported. The estimated values for bearing capacity and traffic-supporting capacity expressed in words should not be assigned specific values. Estimates are generally made to a depth of about 5 feet, and interpretations do not apply to greater depths. Small areas of other soils that have different engineering properties than those listed were included in mapping. Even in these situations, the soil map is useful for planning more detailed field investigations and for suggesting the kinds of problems that may be expected.

The information in this survey can be used to—

1. Make preliminary estimates of the engineering properties of soils that are significant in planning terraces, farm ponds, irrigation systems, and other structures for the conservation of soil and water.
2. Make preliminary evaluations of soil and ground conditions that will aid in selecting locations for highways, airports, and pipelines and in planning detailed investigations of soils at the selected sites.
3. Locate probable sources of topsoil and of sand, gravel, and other construction materials.
4. Correlate performance of engineering structures with soil mapping units to develop information that will be useful in designing and maintaining the structures.
5. Determine the suitability of soils for the cross-country movement of vehicles and construction equipment.
6. Supplement the information obtained from other published maps, reports, and aerial photographs for the purpose of making maps and reports that can be used readily by engineers.
7. Develop other preliminary estimates for construction purposes pertinent to the particular area.

Some of the terms used in this publication have a special meaning to soil scientists and a different meaning to engineers. The Glossary defines many such terms as they are used in soil science. Some of the terms used in engineering are defined in this section.

Much of the information in this section is presented in the form of tables. In table 3 are estimated engineering properties of the soils; in table 4, interpretations of engineering properties; and in table 5, engineering test data.

Estimated engineering properties

Table 3 gives the estimated engineering classifications and some of the estimated physical properties of the soils in Midland County. The estimates are based on the test data in table 5, on field tests, and on experience with similar soils in other counties.

The soils of the county are placed in hydrologic groups A, B, C, or D based on intake of water at the end of long-duration storms that occur after the soil had prior wetting and an opportunity for swelling, and when the soil was without the protection of vegetation. Group A consists mainly of deep, well-drained to excessively drained sands and gravel. These soils have a high infiltration rate, even when wetted; they have a high rate of water transmission and low runoff. Group B consists of moderately deep to deep, moderately fine textured to moderately coarse textured, moderately well drained to well drained soils that have a moderate rate of water transmission. Group C consists of soils that have a slow infiltration rate and a slow rate of water transmission. Group D soils have a very slow rate of water transmission and the highest runoff potential.

The depth to bedrock column in table 3 gives the depth in inches from the surface to consolidated material. The depth to a seasonal high water table is not given because a high water table is not a significant characteristic of the soils of this county.

The percentage passing sieves shows the normal range of soil particles passing the respective screen sizes.

Permeability is the estimated rate in inches per hour that water moves through the soil. The estimates are for each soil as it occurs in place without compaction.

Available water capacity is the capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is expressed as inches of water per inch of soil.

In the reaction column, the degree of acidity or alkalinity of the soil is expressed in pH values.

Salinity of the soils is not given in table 3, because it is not important in most of the soils of the county. There are a few salt lakes, however, and some saline areas along draws in the county. Reeves loam and Gypsum land are the only soils that are influenced by salinity to any extent.

The shrink-swell potential indicates a change in volume that occurs in a soil when the moisture content changes. Knowledge of the shrink-swell potential is important when planning the use of a soil in building roads and other engineering structures. Shrink-swell ratings are low, moderate, high, and very high. In general, deep clay loams, such as those of the Abilene series, have moderate shrink swell potential. A high shrink-swell rating is normally undesirable from the engineering standpoint, because the increase in volume when the dry soil is moistened generally is accompanied by a loss in bearing capacity. Clean sands and gravel (single-grain) and soils that contain small amounts of nonplastic and slightly plastic fines have low shrink-swell potential. Upton gravelly loam is an example.

Engineering interpretations

In table 4 the soils are rated for their suitability as sources of topsoil and road subgrade, and estimates are given of soil features that affect the suitability of the soils or various engineering purposes. The estimates are based on data from tables 3 and 5 and on observations of field performance.

Topsoil is fertile soil that has a relatively high organic matter content. It is used to topdress areas where vegetation is to be established and maintained, such as roadbanks, dams, gardens, and lawns. Normally, only the surface layer is removed for topsoil, but other layers also may be suitable sources.

Road subgrade is the soil material used for building up road grades for supporting base layers. The suitability of a soil for road subgrade depends on its texture, plasticity, shrink-swell potential, traffic-supporting capacity, inherent erodibility, compaction characteristics, and natural water content. Soils that have a high or moderate shrink-swell potential are difficult to place and too compact.

The soil features considered for highway location are those that affect overall performance. Evaluations are made on the basis of an undisturbed soil without artificial drainage. It is assumed that the surface layer will be removed in construction and used for topsoil.

The limitations of soils are listed for supporting foundations of low buildings less than three stories high. The substratum of the natural, undisturbed soil usually provides the base for foundations and is, therefore, the material that needs to be evaluated. It is evaluated in terms of bearing capacity, shrink-swell potential, and shear strength.

Soil features that determine the limitations for septic tank filter fields and sewage lagoon disposal systems are permeability, ground water level, the flooding hazard, slope, depth to rock or other impervious materials, and crevices in rock through which seepage can cause pollution of water supplies.

The limitation of soils for use in reservoir areas depends primarily upon the seepage rate, permeability, and depth to caliche. The highly plastic soils have a low seepage rate. The coarse-textured soils do not have any binding or sealing characteristics, and they are limited by a high seepage rate.

The factors considered in evaluating soils for farm pond embankments are stability, compaction characteristics, susceptibility to piping, shrink-swell potential, compacted permeability, compressibility, erodibility, and gypsum content. Both the subsoil and substratum are evaluated where they are contrasting in character and are thick enough to be used as borrow.

Suitability of the soils for irrigation depends largely on intake rate, available water capacity, depth of soil, slope, and flooding hazard.

Terraces and diversions constructed on coarse-textured soils are difficult to maintain. Soil blowing and water erosion are serious hazards in maintaining terrace ridges and channels at desired specifications.

Waterways on the soils of Midland County have to be carefully stabilized. On highly erodible soils, accumulations of windblown material in waterways create maintenance difficulties.

Steel pipe should have a protective coating to retard corrosion when placed in any soil in the county. Corrosivity ratings are given for soils of the county for steel and concrete in table 4.

Generally, the soils of Midland County are not considered suitable sources of sand or gravel. The soils are not evaluated for agricultural drainage, because drainage is no problem.

Engineering test data

Table 5 shows test data for soil samples from the Springer and Reagan series in Midland County. The tests were performed by the laboratories of the Texas State Highway Department. The data indicate the engineering characteristics of the soil at the specific locations given.

The tests for liquid limit measure the effect of water on the consistence of the soil material. As the moisture content of a clayey soil is increased from a dry state, the material changes from a semisolid to a plastic. The liquid limit is the moisture content

at which the material passes from a plastic to a liquid state. A high liquid limit indicates that the soil has a high content of clay and a low capacity for supporting loads.

The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is plastic.

Engineering classification systems

Agricultural scientists of the U.S. Department of Agriculture (USDA) classify soils according to texture, color, and structure. This system is useful only as the initial step in making engineering classifications of soils. The engineering properties of a soil must be determined or estimated after the initial classifications have been made. Two systems are in general use by engineers for classifying soils. These are the systems used by the American Association of State Highway Officials (*1*) and the Unified system (*7*). These systems are explained briefly in the following paragraphs.

Most highway engineers classify soil material according to the system approved b the American Association of State Highway Officials (AASHO). In this system soil material is classified in seven principal groups. The groups range from A-1, which consists of gravelly soils of high bearing capacity to A-7, which consists of clay soils that have low strength when wet. Within each group the relative load-carrying capacity of the soil material is indicated by a group index number, determined by gradation, liquid limit, and plasticity index. These numbers range from 0 for the best material to 20 for the poorest.

Some engineers prefer to use the Unified Soil Classification System. In this system soil material is grouped into 15 classes. Eight classes are for coarse-grained material (GW, GP, GM, GC, SW, SP, SM, and SC); six are for fine-grained material (ML, CL, OL, MH, CH, and OH); and one (Pt) is for highly organic material. Mechanical analysis and tests for liquid limit anti plasticity index are used to determine the classes of soil material.

Formation and Classification of the Soils

This section describes the outstanding characteristics of the soils of Midland County and relates them to the factors of soil formation. Physical and chemical data are limited for these soils, and the discussion of soil genesis is correspondingly incomplete. The first part of this section discusses the factors of soil formation, the second part describes important processes in the development of soil horizons, and the third part explains the current system of soil classification. Table 6 lists the soil series of the county and gives their classification according to some of the categories of this system.

Factors of Soil Formation

Soil is produced by the action of soil-forming processes on materials deposited or accumulated by geologic agents. The characteristics of a soil at any particular place are determined by (1) the climate in which the soil material has accumulated and has existed since accumulation; (2) the plant and animal life on and in the soil; (3) the physical and mineralogical composition of the parent material; (4) the relief, or lay of the land; and (5) the length of time the climate and living organisms have acted upon the soil material. If any one of these five factors is varied, a different soil is formed.

Climate

The climate of Midland County is semiarid. As a result of the scanty rainfall, the profiles of many of the soils contain free lime. An example is the Gomez soils. As a result of the shallow penetration of moisture, most of the soils have accumulated a horizon of calcium carbonate. High winds, common in the county, have helped to

break down the parent material by reworking many deposits and shifting material from place to place. High evaporation rates have resulted in deposition of salts and gypsum in the vicinity of ancient streambeds and large lakes.

Living organisms

Plants, animals, insects, bacteria, and fungi are important in the formation of soils. Gains in the organic-matter and nitrogen content of the soil, gains or losses in plant nutrients, and changes in soil structure and porosity are among the changes caused by living organisms.

Vegetation, mainly grasses, had a greater effect than other living organisms on soil formation in the county. The limited amounts of vegetation produced soils that generally are low in organic-matter content.

Parent material

Parent material is the unconsolidated mass from which a soil is formed. It determines the limits of the chemical and mineralogical composition of the soil. In Midland County, the parent material is outwash deposits.

Wind has reworked most of this material since it was originally deposited by water. Most of the soils in the county formed in sandy and loamy sediments which are unconsolidated, calcareous, alkaline, and in many cases, reddish colored. The Amarillo and Arvana soils formed in loamy sediments; the Tivoli soils formed in sandy sediments. Other soils, such as those of the Lipan series, formed in clayey sediments. Thin mantles of loamy sediments were deposited on Cretaceous limestone in the southern part of the county. The Reagan and Upton soils formed in these sediments. Draws in the county seldom contain moving waters but they contain loamy sediments in which the Bippus soils formed.

Relief

Relief affects soil formation through its influence on drainage, erosion, plant cover, and soil temperature. Most of Midland County is nearly level, or has slopes of less than 3 percent. A few areas in the county have slopes of as much as 30 percent.

Playas, which are weakly concave depressions that have few if any drainage outlets, have influenced the development of soils in the county.

Time

The length of time that climate, living organisms, and relief have acted on parent material affects the kind of soil that forms. A long time is usually required for distinct horizons to form. The soils of Midland County are old. They differ in degree of horizon development because they have been exposed to soil-forming processes for different lengths of time.

Soil Horizon Differentiation

The marks that the soil-forming factors leave on the soil are recorded in the soil profile—a succession of horizons from the surface down to rock. The horizons differ in thickness and in one or more properties, such as color, texture, structure, consistence, porosity, or reaction.

Most soil profiles contain three major horizons designated A, B, and C. In some young soils a B horizon has not developed.

The A horizon is the surface layer. It can be the horizon of maximum organic-matter content, called the A1 horizon, or the horizon of maximum leaching of dissolved or suspended materials, called the A2.

The B horizon lies immediately beneath the A horizon. It contains a maximum accumulation of dissolved or suspended materials, such as iron or clay. The B

horizon usually is firmer than horizons immediately above and below, and in places it has a blocky structure.

Next is the C horizon. It is relatively little affected by the soil-forming process, but it is modified by weathering.

Several processes involved in the formation of soil horizons in Midland County are: (1) accumulation of organic matter; (2) leaching and accumulation of carbonates and bases; and (3) formation and translocation of silicate clay minerals. In most soils, more than one of these processes have been active in the development of horizons. The leaching of calcium carbonate and translocation of silicate clays are among the more important processes in horizon differentiation in Midland County.

In some places organic matter has accumulated in the upper part of the profile. This has influenced the formation of an A1 horizon. The organic matter coats mineral particles and darkens the A1 horizon as in the Portales and Bippus soils. Overall, the soils of the county are low in organic-matter content.

Leaching of carbonates and bases has occurred in many of the soils. Some moderately leached soils have developed Cca horizons. Thick beds of caliche, or crusted calcium carbonate, are under most of the soils of Midland County, such as the Amarillo soils. Under many soils that are very shallow to moderately deep, such as those of the Kimbrough and Arvana series, the upper part of this caliche layer has become cemented or indurated. In the Reeves soils the leaching and accumulation of calcium sulfate has developed a gypsum horizon.

In some soils of Midland County, the translocation of clay minerals has contributed to horizon development. The B horizon of some soils has an accumulation of clay (clay films) in pores and on ped surfaces. These horizons are designated "B2t" or "Bt" horizons. The Amarillo, Arvana, and Stegall series are examples of soils that have trans-located silicate clays accumulated in the B horizon in the form of clay films.

Classification of the Soils

The system of classifying soils currently used in the United States was adopted for general use by the National Cooperative Soil Survey in 1965 and supplemented in March 1967 and September 1968 (*6*). This system is under continual study, and readers interested in the development of the classification should refer to the latest literature available.

Table 6 shows the classification of each of the soil series represented in the Midland County area according to this system. Miscellaneous land types, such as Gypsum land and Active dune land, are not included. Some of the soils in this county do not fit in a series that has been recognized in the classification system, but recognition of a separate series would not serve a useful purpose. Such soils are named for a series they strongly resemble because they differ from those series in ways too small to be of consequence in interpreting their usefulness or behavior. Such soils are taxadjuncts to the series for which they are named. In this survey the Reeves, Simona, and Upton soils are taxadjuncts to those series. The Reeves soils are not clayey enough, and the Simona and Upton soils are in a more humid environment than is usual for the series.

The current system defines classes in terms of observable or measurable properties of soils (*4*). The properties chosen are primarily those that permit the grouping of soils that are similar in genesis. The classification is designed to encompass all soils. It has six categories. Beginning with the most inclusive, they are the order, the suborder, the great group, the subgroup, the family, and the series. These are briefly defined in the following paragraphs.

Order: The ten soil orders recognized in the current system are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate the soil orders are those that tend to

give a broad climatic grouping of soils. Two exceptions, Entisols and Histosols, occur in many different climates. The six soil orders represented in Midland County are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, and Alfisols.

Entisols are soils that formed in recently deposited mineral material. They are either without genetic horizons or have only the beginning of such horizons. Vertisols are soils in which a natural churning or inversion of soil material takes place, mainly through the swelling and shrinking of clay. *Inceptisols* are soils in which horizons have begun to develop. They are on young, but not recent land surfaces. *Aridisols* are soils that are usually dry when they are not frozen and not irrigated. They show little leaching of calcium carbonate from the solum. *Mollisols* are dark-colored soils that have a high organic-matter content and are soft in consistence when dry. *Alfisols* are soils that have a clay-enriched B horizon in which base saturation is high.

Suborder: Each order is divided into suborders, primarily on the basis of characteristics that seem to produce classes having genetic similarity. Mainly, these characteristics reflect either the presence or absence of waterlogging or soil differences that result from the climate or vegetation. The climatic range is narrower than that of the orders.

Great group: Each order is divided into great groups, on the basis of uniformity in the kinds and sequence of major horizons and similarity of the significant features of corresponding horizons. The horizons considered are those in which clay, iron, or humus have accumulated and those that have pans that interfere with the growth of roots or the movement of water. The features selected are the self-mulching properties of clays, soil temperature, chemical composition (mainly calcium, magnesium, sodium, and potassium), and the like.

Subgroup: Each great group is divided into subgroups, one representing the central (typic) segment of the group, and other groups, called intergrades, that have properties of one great group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in instances where soil properties intergrade outside the range of any other great group, suborder, or order.

Family: Families are established within a subgroup primarily on the basis of properties that affect the growth of plants or the behavior of soils in engineering use. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence.

Series: The series is a group of soils having major horizons that, except for texture of the surface layer, are similar in important characteristics and in arrangement in the profile.

Additional Facts About the County

In this section, the geology and natural resources, climate, farming, and industrial development of the county are discussed.

Geology and Natural Resources

A knowledge of the geology of Midland County is helpful in understanding the soils. A brief history of geologic periods of time and their influence on soils and natural resources is given in the following paragraphs.

During the Permian period of time, a shallow sea (*3*), known as the Permian Basin, covered an area from what is now central Texas to New Mexico. Midland County is in the area where this sea was deepest. The underlying "red bed" sediments were deposited during this period and although they are too deep to influence the soils of the county, they influence its natural resources. As great petroleum reservoirs formed on the bed of the old sea, Midland County and adjacent areas were underlain by large amounts of petroleum, natural gas, and natural gas liquids.

Later, during the Cretaceous period, a shallow arm of the sea deposited sand, clay, and limestone. Fossil-bearing limestone is still visible under the soils in the southern part of Midland County. In some places Cretaceous limestone occurs near the surface of the Upton soils and at a depth of several feet under the Reagan soils.

During later periods of time, fast-flowing streams and rivers influenced the development of soils in the county. They eroded away soil material from the Rocky Mountains and carried these sediments eastward *(2).* The soils of the High Plains developed from these sediments, some of which were either carried or reworked by strong winds.

The most recent soil materials deposited by wind are the duned and undulating Tivoli and Springer soils, which are along Monahans and Midland Draws.

At intervals, processes of geologic erosion entrapped large pools of water in strata of sand and gravel. The most common water-bearing stratum under the High Plains is the Ogallala Formation. These underground water pools are sources of water for irrigation and for urban and industrial uses.

Climate

By Robert B. Orton, State climatologist, National Weather Service, Austin, Tex.

Midland County has a dry steppe climate. Winters are mild and are characterized by frequent cold fronts accompanied by strong, gusty, northerly winds. Most of the cold fronts are dry as they pass through the area. January is the coldest month. In an average January, 22 days have minimum temperatures of 32°F. or below.

The hottest month is July. As shown in table 7, it has an average daily maximum temperature of 94.5° and an average daily minimum temperature of 71.2°. Daytime temperatures are high in summer, but there is a wide diurnal range, and most nights are comfortable.

The weather is most variable late in winter and early in spring. A period of 1 or 2 weeks of warm weather late in February or early in March may be followed by a cold spell later in March. Extreme surface winds are most frequent during this period, and blowing dust occurs when wind velocities are 30 miles an hour or higher. In the most severe dust storms, dust remains suspended in the air for several days after the storm has passed. The sky is occasionally obscured by dust, but in most storms visibility ranges from 1 to 3 miles.

The prevailing wind is from the south-southeast. Relative humidity is lower in Midland County than in the central and eastern parts of the State. The average annual relative humidity is about 75 percent at 6 a.m., but it is only about 45 percent at noon and 37 percent at 6 p.m. The rate of evaporation is high. Evaporation from a National Weather Service class "A" pan averages 105 to 110 inches annually. The mean annual lake evaporation is 72 to 74 inches.

Midland County has an average of 218 freeze-free days a year. The average date of the last freeze in spring is April 3, and the average date of the first freeze in fall is November 6. The county receives approximately 75 percent of the total possible sunshine annually.

Rainfall is rather meager in Midland County; it averages only about 14 inches annually. About 74 percent of this falls in the form of thundershowers during the period May through October, when the prevailing southeasterly winds carry moisture from the Gulf inland to western Texas. The amount of rainfall from thunderstorms is extremely variable from year to year and from place to place within the county.

From November through April frequent cold fronts cut off the moisture from the Gulf and limit the amount of rainfall or snowfall. During the winter season precipitation generally occurs in the form of light rain or drizzle, freezing rain, or snow flurries. Fog and drizzle occur frequently at night but generally clear by noon. Little moisture is derived from the infrequent snowfalls, because the snow is generally accompanied by strong winds that pile it in drifts.

Droughts are rather frequent in Midland County. Periods of several weeks or more without measurable rain are not uncommon. Data on the total annual rainfall are often misleading, because the large amount of rainfall in wet years falls during excessively heavy thundershowers and runs off rapidly. Because of the flatness of the terrain, local flash flooding occurs in places.

Farming and Ranching

The natural resources and climate of Midland County have strongly influenced farming. Although ranching was the main source of income when the county was being settled in the 1880's, fertile soils, such as those of the Amarillo and Arvana series, were well suited to row crops. In the north-central and northeastern parts of the county, most of these soils were plowed and used for crops. As irrigation practices were developed, larger acreages became suitable for cultivation, and now crops account for three-quarters of the farm income.

The fertile soils have influenced range management and livestock production in the county. Livestock are of good quality because the soils and grasses have a high mineral content. Extensive grazing, however, causes brush to infest the range. Large numbers of mesquite shrubs grow on the deep, fertile soils, such as those of the Amarillo series. Control of these shrubs is of major importance in range management.

Industry

The development of the oil industry changed Midland County from a farming and ranching community to an area that has many industries and offices. Exploration, development, and expansion of the oil industry became extensive in 1945, and the county has produced more than 180 million barrels of oil since that time.

In addition to farming and ranching, the soils of the county are now used for road construction, installation of pipelines, and urban and industrial development. The caliche horizon under soils of the Amarillo, Midessa, Arvana, and Kimbrough series is used extensively for road construction. Shallow soils, however, such as those of the Upton and Kimbrough series, hinder pipeline installation.

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Glossary

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as crumbs, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity. The amount of water a soil can hold and make available to plants. It is the numerical difference between the percentage of water at field capacity and the percentage of water at the time plants wilt. The rate is expressed as inches of water per inch of soil depth.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate in many soils of warm-temperate areas, as in the Southwestern States. The material may consist of soft, thin layers in the soil or of hard, thick beds just beneath the solum, or it may be exposed at the surface by erosion.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Eolian soil material. Earthy parent material accumulated through wind action: commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by wind (sand-blast), running water, and other geological agents.

Granular. Having a single mass, or cluster, of many individual soil particles.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Internal drainage, soil. The downward movement of water through the soil profile. The rate of movement is determined by the texture, structure, and other characteristics of the soil profile and underlying layers, and by the height of the water table, either permanent or perched. Relative terms for expressing internal drainage are *none, very slow*, *slow, medium*, *rapid,* and *very rapid.*

Mohs scale. A system of grading hardness of rock using common minerals as standards. The scale is as follows: 1, talc; 2, gypsum; 3, calcite; 4, fluorite; 5, apatite; 6, orthoclase; 7, quartz; 8, topaz: 9, sapphire (corundum); 10, diamond.

Parent material. Disintegrated and partly weathered rock from which soil has formed.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Saline soil. A soil that contains soluble salts in an amount that impairs growth of plants but that does not contain excess exchangeable sodium.

Sand. Individual rock or mineral fragments in soils having diameters ranging from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam*, *silt, sandy clay loam, clay loam, silty clay loam*, *sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

Tables

The Tables in this soil survey contain information that affects land use planning in this survey area. More current data tables may be available from the Web Soil Survey.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Acres	Percent
Abilene clay loam	1, 715	0. 3
Active dune land	150	(1)
Amarillo fine sandy loam, 0 to 1 percent slopes	60, 204	10. 0
Amarillo fine sandy loam, 1 to 3 percent slopes	81, 054	13. 5
Arvana fine sandy loam, 0 to 1 percent slopes	11, 516	1. 9
Arvana fine sandy loam, 1 to 3 percent slopes	11, 603	1. 9
Bippus clay loam	9, 269	1. 5
Gomez fine sandy loam, 0 to 1 percent slopes	6, 290	1. 0
Gomez fine sandy loam, 1 to 3 percent slopes	2, 342	. 4
Gomez loamy fine sand	682	. 1
Gypsum land	6, 773	1. 1
Kimbrough loam	32, 619	5. 4
Kimbrough-Slaughter complex	24, 798	4. 1
Lipan clay	3, 926	. 7
Midessa fine sandy loam, 0 to 1 percent slopes	23, 729	3. 9
Midessa fine sandy loam, 1 to 3 percent slopes	10, 875	1. 8
Miles loamy fine sand, 0 to 3 percent slopes	25, 807	4. 3
Portales loam, 0 to 1 percent slopes	4, 280	. 7
Potter soils	1, 382	. 2
Reagan silty clay loam, 0 to 1 percent slopes	88, 369	14. 7
Reeves loam, 0 to 1 percent slopes	7, 980	1. 3
Sharvana fine sandy loam, 0 to 3 percent slopes	17, 563	2. 9
Simona fine sandy loam, 0 to 3 percent slopes	6, 813	1. 1
Slaughter loam, 0 to 1 percent slopes	11, 737	2. 0
Springer fine sandy loam, 1 to 3 percent slopes	2, 179	. 4
Springer loamy fine sand, 0 to 3 percent slopes	18, 831	3. 1
Stegall loam	3, 355	. 6
Tivoli fine sand	3, 002	. 5
Upton loam, 1 to 3 percent slopes	102, 487	17. 1
Upton-Reagan complex	14, 133	2. 4
Upton gravelly loam, very shallow	3, 930	. 7
Gravel and caliche pits	300	. 1
Total land area	599, 693	99. 9
Salt lakes	627	. 1
Total	600, 320	100. 0

[1] Less than 0.05 percent.

TABLE 2.—*Predicted average yields per acre for cotton and grain sorghum under a high level of management*

[Dashes indicate that crop is not grown at a high level of management or the soil is not suited to that purpose]

Soil	Cotton (lint)		Grain sorghum	
	Dry-land	Irri-gated	Dry-land	Irri-gated
	Lb.	*Lb.*	*Lb.*	*Lb.*
Abilene clay loam	275	850	1, 500	6, 700
Active dune land	-----	-----	-----	-----
Amarillo fine sandy loam, 0 to 1 percent slopes	225	880	1, 400	6, 200
Amarillo fine sandy loam, 1 to 3 percent slopes	200	850	1, 300	5, 600
Arvana fine sandy loam, 0 to 1 percent slopes	200	880	1, 300	6, 200
Arvana fine sandy loam, 1 to 3 percent slopes	200	850	1, 300	5, 600
Bippus clay loam	250	850	1, 200	6, 700
Gomez fine sandy loam, 0 to 1 percent slopes	200	875	1, 200	5, 500
Gomez fine sandy loam, 1 to 3 percent slopes	200	800	1, 200	4, 500
Gomez loamy fine sand	-----	850	1, 100	5, 600
Gypsum land	-----	-----	-----	-----
Kimbrough loam	-----	-----	-----	-----
Kimbrough-Slaughter complex	-----	-----	-----	-----
Lipan clay	-----	-----	-----	-----
Midessa fine sandy loam, 0 to 1 percent slopes	225	875	1, 200	5, 500
Midessa fine sandy loam, 1 to 3 percent slopes	225	800	1, 200	4, 500
Miles loamy fine sand, 0 to 3 percent slopes	-----	800	1, 200	5, 000
Portales loam, 0 to 1 percent slopes	225	850	1, 200	5, 600
Potter soils	-----	-----	-----	-----
Reagan silty clay loam, 0 to 1 percent slopes	175	850	800	5, 600
Reeves loam, 0 to 1 percent slopes	-----	725	-----	3, 900
Sharvana fine sandy loam, 0 to 3 percent slopes	-----	650	700	3, 700
Simona fine sandy loam, 0 to 3 percent slopes	-----	725	600	3, 900
Slaughter loam, 0 to 1 percent slopes	-----	650	-----	3, 600
Springer fine sandy loam, 1 to 3 percent slopes	-----	800	-----	4, 500
Springer loamy fine sand, 0 to 3 percent slopes	-----	-----	-----	3, 300
Stegall loam	200	-----	1, 200	-----
Tivoli fine sand	-----	-----	-----	-----
Upton loam, 1 to 3 percent slopes	-----	-----	-----	-----
Upton-Reagan complex	-----	-----	-----	-----
Upton gravelly loam, very shallow	-----	-----	-----	-----

TABLE 3.—*Estimated engineering properties of the soils*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in such mapping units may have different properties and limitations and for this reason it is necessary to follow carefully the instructions for referring to other series that appear in the first column of this table]

Soil series and map symbols	Hydrologic group	Depth to bedrock	Depth from surface	Classification: USDA texture	Classification—Continued: Unified	Classification—Continued: AASHO	Percentage passing sieve—No. 4	No. 10	No. 40	No. 200	Permeability	Available water capacity	Reaction	Shrink-swell potential
		Inches	*Inches*								*Inches per hour*	*Inches per inch of soil*	*pH value*	
Abilene: Ab	C	>60	0-10	Clay loam	CL	A-6	100	100	95-99	75-95	0.2-0.63	0.15-0.17	6.6-7.8	Moderate.
			10-38	Clay loam	CL	A-6	100	100	95-99	90-95	0.2-0.63	0.18-0.20	6.6-8.4	Moderate.
			38-60	Clay loam	CL	A-6	100	100	90-98	70-80	0.2-0.63	0.13-0.15	7.9-8.4	Moderate.
Active dune land: Ad. (Estimates are not given, because soil material is too variable for reliable evaluation.)														
Amarillo: AfA, AfB	B	>60	0-10	Fine sandy loam	SM	A-4	100	100	95-100	35-45	2.0-6.3	0.11-0.13	6.6-7.8	Low.
			10-44	Sandy clay loam	SC or CL	A-6	100	100	95-100	35-55	0.63-2.0	0.13-0.15	6.6-8.4	Low.
			44-64	Sandy clay loam	SC or CL	A-6	100	100	80-95	35-55	0.63-2.0	0.09-0.11	7.9-8.4	Low.
Arvana: ArA, ArB	C	20-40	0-10	Fine sandy loam	SM	A-4	100	100	95-100	35-50	2.0-6.3	0.11-0.13	7.4-7.8	Low.
			10-32	Sandy clay loam	SC-CL	A-6	100	100	95-100	35-55	0.63-2.0	0.13-0.15	7.4-8.4	Low.
			32-34	Indurated caliche.										
Bippus: Bc	B	>60	0-65	Clay loam	CL	A-6	100	100	80-100	60-70	0.63-2.0	0.15-0.17	7.9-8.4	Low.
Gomez: GmA, GmB	B	>60	0-36	Fine sandy loam	SC	A-6	95-100	90-100	85-98	35-50	2.0-6.3	0.10-0.12	7.9-8.4	Low.
			36-60	Loam	SC	A-6	95-100	90-100	85-98	35-50	2.0-6.3	0.09-0.11	7.9-8.4	Low.
Go	B	>60	0-12	Loamy fine sand	SM	A-2-4	95-100	90-100	85-95	15-25	2.0-6.3	0.06-0.08	7.9-8.4	Low.
			12-36	Fine sandy loam	SC	A-6	95-100	90-100	85-98	35-50	2.0-6.3	0.10-0.12	7.9-8.4	Low.
			36-60	Loam	SC	A-6	95-100	90-100	85-98	35-50	2.0-6.3	0.09-0.11	7.9-8.4	Low.
Gypsum land: Gy. (Estimates are not given, because soil material is too variable for reliable evaluation.)														
*Kimbrough: Kb, Ks. For Slaughter part of Ks, see Slaughter series.	C	7-10	0-8	Loam	CL	A-6	100	100	90-95	60-75	0.63-2.0	0.13-0.15	7.4-8.4	Low.
			8-10	Indurated caliche.										
Lipan: Lp	D	>60	0-60	Clay	CH	A-7	100	100	90-95	80-95	<0.06	0.15-0.17	7.4-8.4	High.
Midessa: MdA, MdB	B	>60	0-8	Fine sandy loam	SM or ML	A-4	100	95-100	85-95	40-55	0.63-2.0	0.10-0.12	7.9-8.4	Low.
			8-32	Sandy clay loam	SC or CL	A-6	100	95-100	90-100	35-55	0.63-2.0	0.12-0.14	7.9-8.4	Low.
			32-62	Loam	CL	A-6	100	80-95	70-95	60-70	0.63-2.0	0.09-0.11	7.9-8.4	Low.
Miles: MmB	B	>60	0-14	Loamy fine sand	SM	A-2-4	100	100	80-95	15-25	2.0-6.3	0.09-0.11	6.6-7.3	Low.
			14-20	Fine sandy loam	SM	A-4	100	100	80-95	35-50	2.0-6.3	0.11-0.13	6.6-7.3	Low.
			20-62	Sandy clay loam	SC or CL	A-6	100	100	90-97	35-55	0.63-2.0	0.13-0.15	6.6-7.8	Low.
Portales: PaA	B	>60	0-12	Loam	CL	A-6	100	100	90-100	60-75	0.63-2.0	0.13-0.15	7.9-8.4	Low.
			12-36	Clay loam	CL	A-6	100	100	90-100	60-75	0.63-2.0	0.13-0.15	7.9-8.4	Low.
			36-60	Clay loam	CL	A-6	100	100	90-100	60-75	0.63-2.0	0.08-0.10	7.9-8.4	Low.
Potter: Pt	C	4-12	0-6	Gravelly loam	SC or CL	A-2-4 or A-6	70-90	45-85	45-80	15-55	0.63-2.0	0.13-0.15	7.9-8.4	Low.
			6-50	Platy caliche.										
Reagan: ReA	B	>60	0-34	Silty clay loam	CL	A-6	95-100	95-100	85-100	70-90	0.63-2.0	0.15-0.17	7.9-8.4	Low.
			34-64	Silty clay loam	CL	A-6 or A-7	95-100	95-100	70-95	70-90	0.63-2.0	0.13-0.15	7.9-8.4	Low.
Reeves: RvA	C	20-40	0-7	Loam	ML-CL	A-4	95-100	95-100	85-95	60-75	0.63-2.0	0.14-0.16	7.9-8.4	Low.
			7-24	Clay loam	CL	A-6	95-100	95-100	80-95	70-80	0.63-2.0	0.14-0.16	7.9-8.4	Low.
			24-42	Mealy gypsiferous material.										
Sharvana: SaB	C	8-20	0-6	Fine sandy loam	SM	A-4	100	100	80-95	35-50	2.0-6.3	0.11-0.13	6.6-7.3	Low.
			6-14	Sandy clay loam	SC or CL	A-6	100	100	90-97	35-55	0.63-2.0	0.13-0.15	6.6-7.3	Low.
			14-24	Indurated platy caliche.										
Simona: SfB	C	12-20	0-5	Fine sandy loam	SM	A-4	100	100	95-100	35-50	2.0-6.3	0.10-0.12	7.9-8.4	Low.
			5-15	Fine sandy loam	SM	A-4	100	100	95-100	35-50	2.0-6.3	0.14-0.16	7.9-8.4	Low.
			15-17	Strongly cemented platy caliche.										
Slaughter: SlA	C	9-20	0-5	Loam	CL	A-6	100	100	90-95	70-80	0.2-0.63	0.15-0.17	6.6-8.4	Low.
			5-15	Clay loam	CL	A-6	100	100	90-95	70-80	0.2-0.63	0.15-0.17	6.6-8.4	Moderate.
			15	Platy caliche.										

TABLE 3.—*Estimated engineering properties of the soils*—Continued

Soil series and map symbols	Hydrologic group	Depth to bedrock	Depth from surface	Classification: USDA texture	Classification—Continued: Unified	Classification—Continued: AASHO	Percentage passing sieve—No. 4	No. 10	No. 40	No. 200	Permeability	Available water capacity	Reaction	Shrink-swell potential
		Inches	*Inches*								*Inches per hour*	*Inches per inch of soil*	*pH value*	
Springer: SnB	B	>60	0-12	Fine sandy loam	SM or SM-SC	A-2-4	100	100	85-98	15-30	2.0-6.3	0.10-0.12	6.6-7.8	Low.
			12-60	Fine sandy loam	SM or SM-SC	A-2-4	100	100	85-98	15-30	2.0-6.3	0.08-0.10	6.6-7.8	Low.
SpB	B	>60	0-15	Loamy fine sand	SM or SM-SC	A-2-4	100	100	85-98	12-25	6.3-20.0	0.08-0.10	6.6-8.4	Low.
			15-60	Fine sandy loam	SM or SM-SC	A-2-4	100	100	85-98	15-30	2.0-6.3	0.09-0.11	6.6-8.4	Low.
Stegall: St	C	20-36	0-10	Loam	CL	A-6	100	100	90-95	60-75	0.2-0.63	0.15-0.17	6.6-7.3	Low.
			10-30	Clay loam	CL	A-6	100	100	90-95	70-80	0.2-0.63	0.16-0.18	6.6-7.3	Moderate.
			30-34	Indurated platy caliche.										
Tivoli: Tf	A	>60	0-60	Fine sand	SP-SM or SM	A-3-4	100	100	65-70	10-20	6.3-20.0	0.04-0.06	6.6-7.8	Low.
*Upton: UpB, Ur. For Reagan part of Ur, see Reagan series.	C	6-20	0-5	Loam	CL	A-6	100	100	90-95	60-75	0.63-2.0	0.15-0.17	7.9-8.4	Low.
			5-15	Clay loam	CL	A-6	100	100	90-95	70-80	0.63-2.0	0.09-0.11	7.9-8.4	Low.
			15-20	Platy caliche.										
Ur	C	4-6	0-6	Gravelly loam	SC or CL	A-2-4 or A-6	70-90	45-85	45-80	15-55	0.63-2.0	0.13-0.15	7.9-8.4	Low.
			6	Indurated platy caliche underlain by hard limestone.										

TABLE 4.—*Interpretations of engineering properties of the soils*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for referring to other series that appear in the first column of this table]

Soil series and map symbols	Suitability as source of— Topsoil	Suitability as source of— Road subgrade	Degree of limitations for— Highway location	Degree of limitations for— Foundations for low buildings [1]	Degree of limitations for— Septic tank filter fields	Degree of limitations for— Sewage lagoons	Farm ponds: Reservoir area	Farm ponds: Embankments	Soil features affecting— Irrigation	Soil features affecting— Terraces and diversions	Soil features affecting— Waterways	Soil corrosivity for— Uncoated steel	Soil corrosivity for— Concrete
Abilene: Ab	Fair: clay loam texture.	Fair: fair traffic-supporting capacity; moderate shrink-swell potential.	Moderate: fair traffic-supporting capacity; moderate shrink-swell potential.	Moderate: fair bearing capacity; moderate shrink-swell potential.	Severe: moderately slow permeability.	Slight.	Moderate: moderately slow permeability.	Moderate: medium compressibility.	Slow intake rate.	All features favorable.	All features favorable.	High: clay loam texture.	Low.
Active dune land: Ad. (Estimates are not given, because soil material is too variable for reliable evaluation.)													
Amarillo: AfA, AfB	Fair: 7 to 16 inches of fine sandy loam.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Moderate: fair bearing capacity.	Slight.	Moderate: moderate permeability.	Moderate: moderate permeability.	Moderate: medium compressibility; fair stability.	Slope.	All features favorable.	All features favorable.	Moderate: sandy clay loam texture.	Low.
Arvana: ArA, ArB	Fair: 8 to 12 inches of fine sandy loam.	Fair: fair traffic-supporting capacity.	Severe if indurated caliche is at a depth of 20 to 36 inches, but moderate if indurated caliche is at a depth of 36 to 40 inches; fair traffic-supporting capacity.	Moderate: fair bearing capacity.	Severe: indurated caliche at a depth of 20 to 40 inches.	Severe: indurated caliche at a depth of 20 to 40 inches.	Severe if indurated caliche is at a depth of 20 to 36 inches, moderate if indurated caliche is at a depth of 36 to 40 inches; moderate permeability.	Severe where borrow material is 20 to 24 inches thick, moderate where borrow material is 24 to 40 inches thick.	Indurated caliche at a depth of 20 to 40 inches.	Indurated caliche at a depth of 20 to 40 inches.	Indurated caliche at a depth of 20 to 40 inches.	High: high conductivity.	Low.

See footnote at end of table.

421-878—73——5

TABLE 4.—*Interpretations of engineering properties of the soils*—Continued

Soil series and map symbols	Suitability as source of— Topsoil	Suitability as source of— Road subgrade	Degree of limitations for— Highway location	Degree of limitations for— Foundations for low buildings [1]	Degree of limitations for— Septic tank filter fields	Degree of limitations for— Sewage lagoons	Farm ponds: Reservoir area	Farm ponds: Embankments	Soil features affecting— Irrigation	Soil features affecting— Terraces and diversions	Soil features affecting— Waterways	Soil corrosivity for— Uncoated steel	Soil corrosivity for— Concrete
Bippus: Bc	Fair: clay loam texture.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Moderate: fair bearing capacity.	Moderate: moderate permeability.	Moderate: moderate permeability.	Moderate: moderate permeability.	Moderate: medium compressibility.	Moderate intake rate.	Receives outside water.	All features favorable.	Moderate: clay loam texture.	Low.
Gomez: GmA, GmB	Good.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Moderate: fair bearing capacity.	None to slight.	Severe: moderately rapid permeability.	Severe: moderately rapid permeability.	Moderate: poor resistance to piping and erosion.	Rapid intake rate.	Poor stability; erodible.	Poor stability; erodible.	High: high conductivity.	Low.
Go	Poor: loamy fine sand texture.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Moderate: fair bearing capacity.	None to slight.	Severe: moderately rapid permeability.	Severe: moderately rapid permeability.	Moderate: poor resistance to piping and erosion.	Rapid intake rate.	Poor stability; erodible.	Poor stability; erodible.	High: high conductivity.	Low.
Gypsum land: Gy. (Estimates are not given, because soil material is too variable for reliable evaluation.)													
*Kimbrough: Kb, Ks. For Slaughter part of Ks, see Slaughter series.	Fair: 7 to 10 inches of loam.	Poor: indurated caliche at a depth of 7 to 10 inches.	Severe: indurated caliche at a depth of 7 to 10 inches.	Severe: indurated caliche at a depth of 7 to 10 inches.	Severe: indurated caliche at a depth of 7 to 10 inches.	Severe: indurated caliche at a depth of 7 to 10 inches.	Severe: indurated caliche at a depth of 7 to 10 inches.	Severe: indurated caliche at a depth of 7 to 10 inches.	Indurated caliche at a depth of 7 to 10 inches.	Indurated caliche at a depth of 7 to 10 inches.	Indurated caliche at a depth of 7 to 10 inches.	High: high conductivity.	Low.
Lipan: Lp	Poor: clay texture.	Poor: high shrink-swell potential; poor traffic-supporting capacity.	Severe: high shrink-swell potential; poor traffic-supporting capacity.	Severe: high shrink-swell potential; poor bearing capacity.	Severe: very slow permeability.	Slight.	Slight.	Moderate: high compressibility.	Slow intake rate.	Depressional topography.	All features favorable.	High: clay texture.	Low.
Midessa: MdA, MdB	Fair: 6 to 10 inches of fine sandy loam.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Moderate: fair bearing capacity.	Moderate: moderate permeability.	Moderate: moderate permeability.	Moderate: moderate permeability.	Moderate: poor resistance to piping and erosion.	All features favorable.	All features favorable.	All features favorable.	High: high conductivity.	Low.
Miles: MmB	Poor: loamy fine sand texture.	Good.	Slight.	Slight.	Slight.	Moderate: moderate permeability.	Moderate: moderate permeability.	Moderate: fair stability.	Rapid intake rate.	Moderate hazard of soil blowing.	Moderate hazard of soil blowing.	Moderate: sandy clay loam texture.	Low.
Portales: PoA	Fair: clay loam texture.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Moderate: fair bearing capacity.	Slight.	Moderate: moderate permeability.	Moderate: moderate permeability.	Moderate: medium compressibility.	All features favorable.	All features favorable.	All features favorable.	Moderate: clay loam texture.	Low.
Potter: Pt	Poor where loam is 4 to 6 inches thick; fair where loam is 6 to 12 inches thick.	Poor: 4 to 12 inches of material.	Severe: platy caliche at a depth of 4 to 12 inches.	Severe: platy caliche at a depth of 4 to 12 inches.	Severe: platy caliche at a depth of 4 to 12 inches.	Severe: platy caliche at a depth of 4 to 12 inches.	Severe: platy caliche at a depth of 4 to 12 inches.	Severe: platy caliche at a depth of 4 to 12 inches.	Nonarable.	Nonarable.	Nonarable.	Low.	Low.
Reagan: ReA	Fair: silty clay loam texture.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Moderate: fair bearing capacity.	Slight.	Moderate: moderate permeability.	Moderate: moderate permeability.	Moderate: medium compressibility.	All features favorable.	All features favorable.	All features favorable.	High: high conductivity.	Low.
Reeves: RvA	Fair: 4 to 10 inches of loam.	Poor if suitable material is 20 to 24 inches thick, fair if suitable material is 24 to 40 inches thick; fair traffic-supporting capacity.	Severe if gypsum is at a depth of 20 to 36 inches, but moderate if gypsum is at a depth of 36 to 40 inches; moderate traffic-supporting capacity.	Moderate: fair bearing capacity.	Slight.	Moderate: moderate permeability.	Moderate: moderate permeability.	Moderate: poor resistance to piping and erosion.	Gypsum at a depth of 20 to 40 inches.	Gypsum at a depth of 20 to 40 inches.	Gypsum at a depth of 20 to 40 inches.	High: high conductivity.	Low.

See footnote at end of table.

TABLE 4.—*Interpretations of engineering properties of the soils*—Continued

Soil series and map symbols	Suitability as source of— Topsoil	Suitability as source of— Road subgrade	Degree of limitations for— Highway location	Degree of limitations for— Foundations for low buildings [1]	Degree of limitations for— Septic tank filter fields	Degree of limitations for— Sewage lagoons	Farm ponds: Reservoir area	Farm ponds: Embankments	Soil features affecting— Irrigation	Soil features affecting— Terraces and diversions	Soil features affecting— Waterways	Soil corrosivity for— Uncoated steel	Soil corrosivity for— Concrete
Sharvana: SaB	Fair: 4 to 8 inches of fine sandy loam.	Poor: 8 to 20 inches of suitable material.	Severe: indurated caliche at a depth of 8 to 20 inches.	Severe: indurated caliche at a depth of 8 to 20 inches.	Severe: indurated caliche at a depth of 8 to 20 inches.	Severe: indurated caliche at a depth of 8 to 20 inches.	Severe: indurated caliche at a depth of 8 to 20 inches.	Severe: 8 to 20 inches of borrow material.	Indurated caliche at a depth of 8 to 20 inches.	Indurated caliche at a depth of 8 to 20 inches.	Indurated caliche at a depth of 8 to 20 inches.	High: high conductivity.	Low.
Simona: SfB	Fair: 4 to 10 inches of fine sandy loam.	Poor: 12 to 20 inches of suitable material.	Severe: strongly cemented caliche at a depth of 12 to 20 inches.	Severe: strongly cemented caliche at a depth of 12 to 20 inches.	Severe: strongly cemented caliche at a depth of 12 to 20 inches.	Severe: strongly cemented caliche at a depth of 12 to 20 inches.	Severe: strongly cemented caliche at a depth of 12 to 20 inches.	Severe: 12 to 20 inches of borrow material.	Strongly cemented caliche at a depth of 12 to 20 inches.	Strongly cemented caliche at a depth of 12 to 20 inches.	Strongly cemented caliche at a depth of 12 to 20 inches.	High: high conductivity.	Low.
Slaughter: SlA	Fair: 4 to 8 inches of loam.	Poor: 9 to 20 inches of suitable material.	Severe: indurated caliche at a depth of 9 to 20 inches.	Severe: indurated caliche at a depth of 9 to 20 inches.	Severe: indurated caliche at a depth of 9 to 20 inches.	Severe: indurated caliche at a depth of 9 to 20 inches.	Severe: indurated caliche at a depth of 9 to 20 inches.	Severe: 9 to 20 inches of borrow material.	Indurated caliche at a depth of 9 to 20 inches.	Indurated caliche at a depth of 9 to 20 inches.	Indurated caliche at a depth of 9 to 20 inches.	High: high conductivity.	Low.
Springer: SnB	Fair: 10 to 20 inches of fine sandy loam.	Good.	Slight if slope is 0 to 6 percent; moderate if slope is 6 to 8 percent.	Slight if slope is 0 to 6 percent; moderate if slope is 6 to 8 percent.	Slight.	Severe: moderately rapid permeability.	Severe: moderately rapid permeability.	Moderate: poor resistance to piping and soil blowing.	Rapid intake rate.	Moderate hazard of soil blowing.	Moderate hazard of soil blowing.	Low.	Low.
SpB	Poor: loamy fine sand texture.	Good.	Slight if slope is 0 to 6 percent; moderate if slope is 6 to 8 percent.	Slight if slope is 0 to 6 percent; moderate if slope is 6 to 8 percent.	Slight.	Severe: moderately rapid permeability.	Severe: moderately rapid permeability.	Moderate: poor resistance to piping and soil blowing.	Rapid intake rate.	Severe hazard of soil blowing; undulating and hummocky topography.	Severe hazard of soil blowing.	Low.	Low.
Stegall: St	Fair: 8 to 12 inches of loam.	Fair: fair traffic-supporting capacity.	Severe: indurated caliche at a depth of 20 to 36 inches.	Moderate: fair bearing capacity.	Severe: indurated caliche at a depth of 20 to 36 inches.	Severe: indurated caliche at a depth of 20 to 36 inches.	Moderate: moderate permeability.	Moderate: medium compressibility.	Indurated caliche at a depth of 20 to 36 inches.	All features favorable.	All features favorable.	High: high conductivity.	Low.
Tivoli: Tf	Poor: fine sand texture.	Good.	Moderate: 1 to 5 percent slopes.	Moderate: 1 to 5 percent slopes.	Severe: inadequate filtration.	Severe: rapid permeability.	Severe: Trapid permeability.	Severe: poor resistance to piping and soil blowing; poor stability.	High intake rate; low available water capacity; dune topography.	Dune topography; severe hazard of soil blowing.	Severe hazard of soil blowing.	Low.	Low.
*Upton: UpB, Ur. For Reagan part of Ur, see Reagan series.	Poor: 4 to 6 inches of loam; 2 to 35 percent coarse fragments.	Poor: 6 to 20 inches of suitable material.	Severe: indurated caliche at a depth of 6 to 20 inches.	Severe: indurated caliche at a depth of 6 to 20 inches.	Severe: indurated caliche at a depth of 6 to 20 inches.	Severe: indurated caliche at a depth of 6 to 20 inches.	Severe: indurated caliche at a depth of 6 to 20 inches.	Severe: 6 to 20 inches of borrow material.	Indurated caliche at a depth of 6 to 20 inches.	Indurated caliche at a depth of 6 to 20 inches.	Indurated caliche at a depth of 6 to 20 inches.	High: high conductivity.	Low.
Ut	Poor: 4 to 6 inches of loam; 20 to 30 percent coarse fragments.	Poor: 4 to 6 inches of suitable material.	Severe: indurated caliche at a depth of 4 to 6 inches.	Severe: indurated caliche at a depth of 4 to 6 inches.	Severe: indurated caliche at a depth of 4 to 6 inches.	Severe: indurated caliche at a depth of 4 to 6 inches.	Severe: indurated caliche at a depth of 4 to 6 inches.	Severe: 4 to 6 inches of borrow material.	Nonarable.	Nonarable.	Nonarable.	High: high conductivity.	Low.

[1] Engineers and others should not apply specific values to the estimates given for bearing capacity of soils.

TABLE 5.—*Engineering test data*

[Tests performed by the Texas State Highway Department in accordance with standard procedures of the American Association of State Highway Officials (AASHO) (*1*)]

Soil name	Texas report No.	Depth from surface	Mechanical analysis[1] — Percentage passing sieve— No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 20 (0.84 mm.)	Mechanical analysis—Continued — Percentage passing sieve—Con. No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	Percentage smaller than— 0.05 mm.	0.005 mm.	0.002 mm.	Liquid limit	Plasticity index	Classification — AASHO	Unified[2]
Reagan silty clay loam:		*Inches*									*Percent*			
(Modal profile) 0.7 mile west of Farm Road 1379 at a point 6.6 miles south of intersection with Texas Hwy. 158 in Spraberry.	64-532-R	7-26	100	99	98	97	75	67	40	32	33	17	A-6(11)	CL
	64-533-R	26-40	99	98	97	95	81	79	54	45	31	16	A-6(10)	CL
	64-534-R	40-80	97	95	94	92	73	65	44	36	32	18	A-6(11)	CL
Springer loamy fine sand:														
(Modal profile) 0.8 mile east of Farm Road 1379 at a point 2.8 miles south of Greenwood school, 9 miles east of Midland.	64-541-R	0-18			100	96	14	14	9	8	20	4	A-2(0)	SM-SC
	64-542-R	18-72			100	94	20	18	14	13	19	3	A-2(0)	SM
(Nonmodal, less clayey in the B2 horizon) 0.5 mile east of Farm Road 1379 at a point 2.8 miles south of Greenwood school, 9 miles east of Midland.	64-538-R	0-17			100	95	14	13	8	7	18	3	A-2(0)	SM
	64-539-R	17-48			100	97	17	16	11	10	18	2	A-2(0)	SM
	64-540-R	48-72			100	94	30	26	19	17	22	7	A-2(0)	SM-SC

[1] Mechanical analysis according to AASHO Designation: T 88-57 (*1*). Results by this procedure differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method, and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method, and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analysis data used in this table are not suitable for naming textural classes for soils.

[2] SCS and the Bureau of Public Roads have agreed to consider that all soils having plasticity indexes within two points of A-line are to be given a borderline classification. An example of a borderline classification obtained by this use is SM-SC.

TABLE 6.—*Classification of soil series*

Series	Family	Subgroup	Order
Abilene	Fine, mixed, thermic	Pachic Argiustolls	Mollisols.
Amarillo	Fine-loamy, mixed, thermic	Aridic Paleustalfs	Alfisols.
Arvana	Fine-loamy, mixed, thermic	Aridic Petrocalcic Paleustalfs	Alfisols.
Bippus	Fine-loamy, mixed, thermic	Cumulic Haplustolls	Mollisols.
Gomez	Coarse-loamy, mixed, thermic	Typic Ustochrepts	Inceptisols.
Kimbrough	Loamy, mixed, thermic, shallow	Petrocalcic Calciustolls	Mollisols.
Lipan	Fine, montmorillonitic, thermic	Entic Pellusterts	Vertisols.
Midessa	Fine-loamy, mixed, thermic	Typic Ustochrepts	Inceptisols.
Miles	Fine-loamy, mixed, thermic	Udic Paleustalfs	Alfisols.
Portales	Fine-loamy, mixed, thermic	Aridic Calciustolls	Mollisols.
Potter	Loamy, carbonatic, thermic, shallow	Ustollic Calciorthids	Aridisols.
Reagan	Fine-silty, mixed, thermic	Ustollic Calciorthids	Aridisols.
Reeves	Fine-gypsic, thermic	Typic Calciorthids	Aridisols.
Sharvana	Loamy, mixed, thermic, shallow	Petrocalcic Ustalfic Paleargids	Aridisols.
Simona	Loamy, carbonatic, thermic, shallow	Typic Paleorthids	Aridisols.
Slaughter	Clayey, mixed, thermic, shallow	Aridic Petrocalcic Paleustolls	Mollisols.
Springer	Coarse-loamy, mixed, thermic	Udic Paleustalfs	Alfisols.
Stegall	Fine, mixed, thermic	Aridic Petrocalcic Paleustolls	Mollisols.
Tivoli	Mixed, thermic	Typic Ustipsamments	Entisols.
Upton	Loamy, carbonatic, thermic, shallow	Typic Paleorthids	Aridisols.

TABLE 7.—*Climatological data*

[Data for Midland, Tex., based on records for the period 1948-64]

Temperature

Month	Normal[1] Daily maximum	Normal Daily minimum	Normal Monthly	Extremes — Highest recorded temperature	(Year)	Lowest recorded temperature	(Year)	Mean number of days[2] — Maximum temperature is— 90° F. and above	32° F. and below	Minimum temperature is— 32° F. and below	0° F. and below	Normal degree days[1]
	° F.	° F.	° F.	° F		° F						
January	57.1	30.9	44.0	83	1950	−8	1962	0	1	22	(4)	651
February	61.2	35.4	48.3	87	1957	−1	1951	0	1	13	0	468
March	68.9	41.5	55.2	90	1956	10	1948	0	(4)	7	0	322
April	78.5	51.2	64.9	96	1955	28	1957	4	0	0	0	90
May	86.2	60.6	73.4	107	1953	39	1954	16	0	0	0	0
June	93.1	69.3	81.2	109	1951	51	1964	24	0	0	0	0
July	94.5	71.2	82.9	106	1964	56	1952	21	0	0	0	0
August	94.1	70.2	82.2	107	1964	60	1961	21	0	0	0	0
September	87.7	63.1	75.4	107	1953	46	1951	13	0	0	0	0
October	78.6	53.1	65.9	98	1951	32	1949	5	0	0	0	87
November	66.3	38.7	52.5	86	1950	16	1950	0	0	4	0	381
December	59.6	32.2	45.9	85	1954	8	1950	0	1	18	0	592
Year	77.2	51.5	64.3	109	1951	−8	1962	109	3	64	(4)	2,591

Precipitation

Month	Normal total precipitation[1]	Greatest daily amount[3] — Amount	Year	Total in— Driest year (1951)	Wettest year (1961)	One year in 10 will have— Less than	More than	Mean number of days having— 0.10 inch or more	0.50 inch or more	1 inch or more	Snow and sleet — Mean total monthly	Maximum monthly — Amount	Year
	Inches	*Inches*		*Inches*	*Inches*	*Inches*	*Inches*				*Inches*	*Inches*	
January	0.80	1.15	1958	0.01	1.33	0.11	2.03	2	(4)	(4)	1.4	7.7	1949
February	.60	1.07	1958	.39	.43	.07	1.57	2	(4)	0	.8	2.8	1960
March	.36	.64	1964	.26	1.12	.05	1.04	1	(4)	0	.3	3.5	1962
April	.83	1.18	1954	.40	.02	.10	2.11	2	(4)	0	(5)	(5)	1949
May	2.08	2.08	1964	.86	2.63	.17	4.55	4	2	1	0	0	
June	1.63	2.12	1961	.05	2.96	.15	3.69	3	1	(4)	0	0	
July	1.88	5.99	1961	.05	6.73	.19	4.63	4	1	(4)	0	0	
August	1.48	1.56	1958	1.26	.21	.23	3.21	3	1	1	0	0	
September	1.79	2.16	1962	.34	3.12	.21	4.18	3	1	1	0	0	
October	1.66	1.79	1959	.42	.03	.33	3.59	3	1	(4)	(5)	(5)	1958
November	.47	1.19	1961	.05	1.63	.06	1.41	1	(4)	(4)	.1	1.1	1957
December	.66	.93	1960	.15	.33	.06	1.55	1	(4)	0	.4	4.8	1960
Year	14.24	5.99	1961	4.24	20.54	7.43	21.61	29	7	3	3.0	7.7	1949

[1] Climatological standard normals (1931-60) using data from comparable locations.
[2] For comparable locations 1960-62.
[3] For comparable locations 1954-64.
[4] Less than one-half.
[5] Trace.

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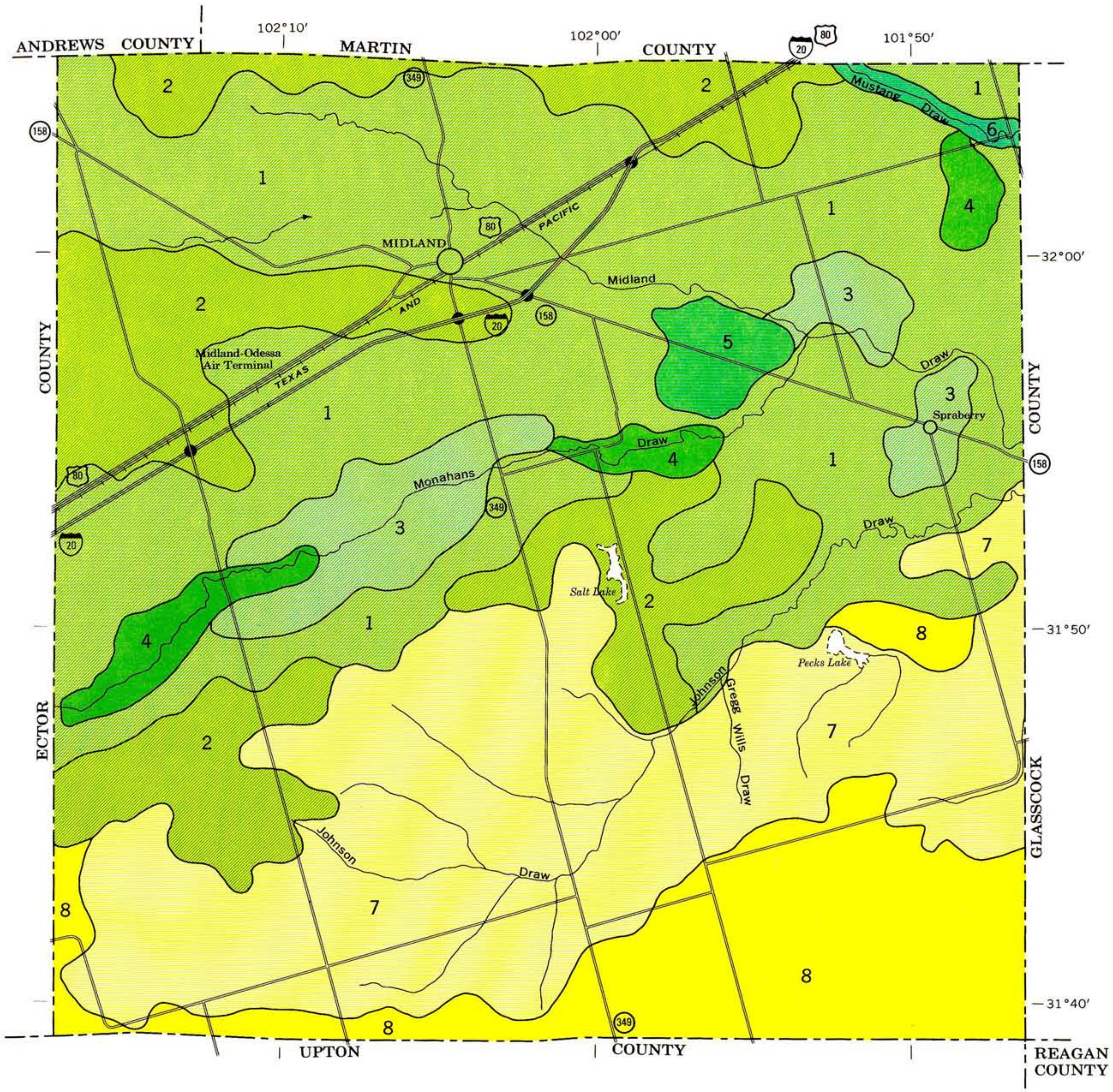
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

TEXAS AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

MIDLAND COUNTY, TEXAS

Scale 1:253 440



N

SOIL ASSOCIATIONS*

SOILS OF THE HIGH PLAINS

- 1 — Amarillo-Arvana-Midessa association: Nearly level to gently sloping, deep to moderately deep fine sandy loams
- 2 — Kimbrough-Slaughter association: Nearly level to gently sloping, very shallow and shallow loams
- 3 — Springer-Miles association: Nearly level to gently sloping, deep loamy fine sands and fine sandy loams
- 4 — Reeves-Gypsum land association: Nearly level to moderately steep, very shallow to moderately deep loams and Gypsum land
- 5 — Tivoli-Springer association: Duned and undulating, deep fine sands and loamy fine sands
- 6 — Bippus-Potter association: Nearly level to steep, deep and very shallow clay loams and gravelly loams

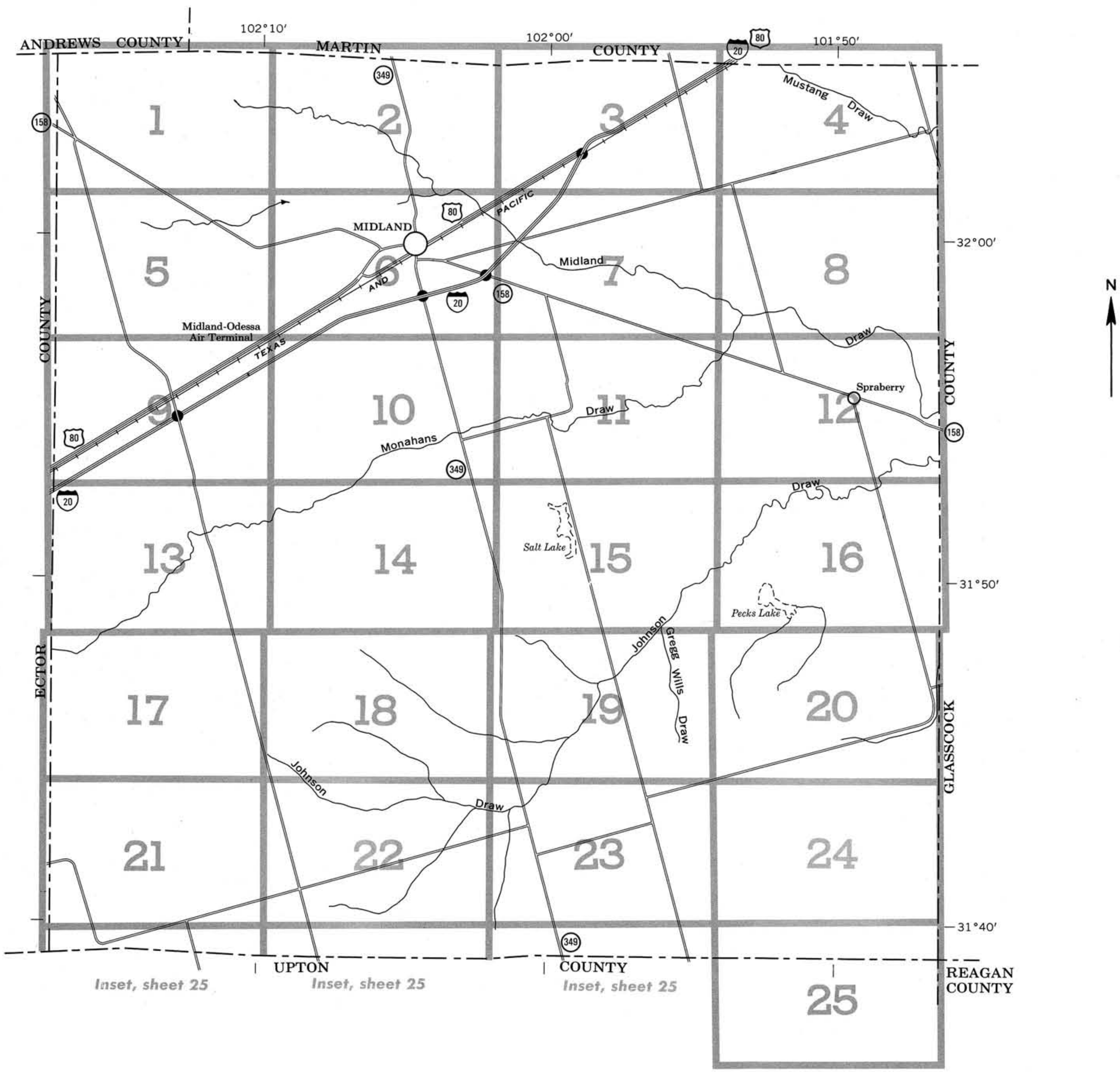
SOILS OF THE EDWARDS PLATEAU

- 7 — Upton association: Gently sloping to sloping, shallow to very shallow loams
- 8 — Reagan-Upton association: Nearly level to gently sloping, deep to very shallow loams and silty clay loams

*The terms for texture in the descriptive heading of each association apply to the surface layer.

Published 1972

This map is for general planning. It shows only the major soils and does not contain sufficient detail for operational planning.



INDEX TO MAP SHEETS

MIDLAND COUNTY, TEXAS

Scale 1:253 440

1 0 1 2 3 4 Miles

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Dual
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State or county
- Farm or ranch to market

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail
- Railroad
- Ferry (FY)
- Ford (FORD)
- Grade
- R. R. over
- R. R. under

Tunnel

Buildings
- School
- Church

Mine and quarry

Gravel pit

Power line

Pipeline

Cemetery

Dams

Levee

Cotton gin

Windmill

BOUNDARIES

- National or state
- County
- Reservation
- Land grant
- Small park, cemetery, airport
- Land survey division corners

DRAINAGE

Streams, double-line
- Perennial
- Intermittent

Streams, single-line
- Perennial
- Intermittent
  - Crossable with tillage implements
  - Not crossable with tillage implements
  - Unclassified

Canals and ditches (CANAL)

Lakes and ponds
- Perennial (water) (w)
- Intermittent (int)

Spring

Marsh or swamp

Wet spot

Alluvial fan

Drainage end

RELIEF

Escarpments
- Bedrock
- Other

Prominent peak

Depressions (Large, Small)
- Unclassified

SOIL SURVEY DATA

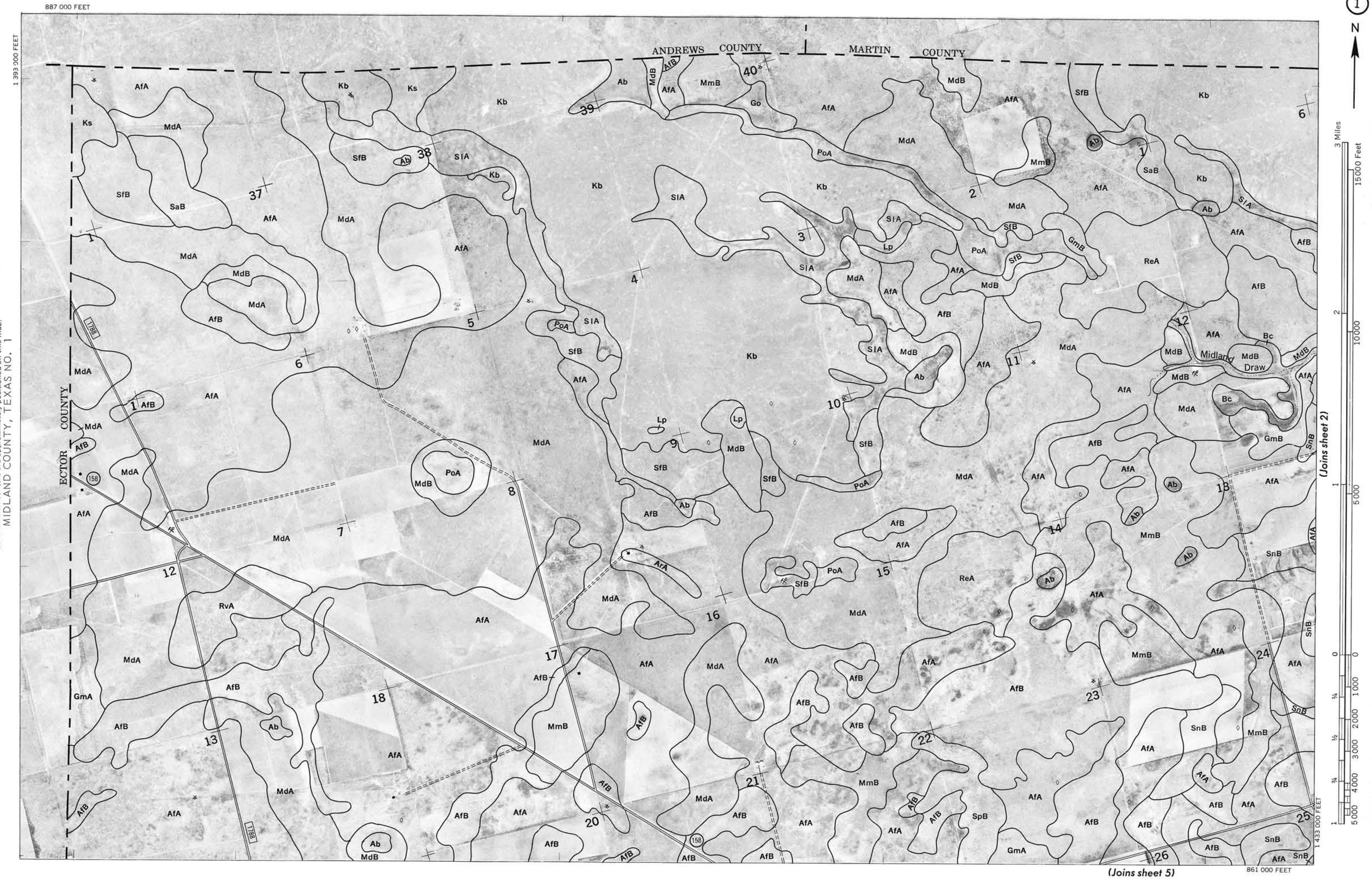
- Soil boundary and symbol (Dx)
- Gravel
- Stoniness: Stony; Very stony
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gully

SOIL LEGEND

The first capital letter is the initial one of the soil name. A second capital letter, A or B, shows the slope. Most symbols without a slope letter are those of nearly level soils or land types, but some are for soils or land types that have a considerable range of slope. (W) following the soil name indicates that signs of erosion, especially of local shifting of soil by wind, are evident in places, but the degree of erosion cannot be estimated reliably.

SYMBOL	NAME
Ab	Abilene clay loam
Ad	Active dune land (W)
AfA	Amarillo fine sandy loam, 0 to 1 percent slopes
AfB	Amarillo fine sandy loam, 1 to 3 percent slopes
ArA	Arvana fine sandy loam, 0 to 1 percent slopes
ArB	Arvana fine sandy loam, 1 to 3 percent slopes
Bc	Bippus clay loam
GmA	Gomez fine sandy loam, 0 to 1 percent slopes
GmB	Gomez fine sandy loam, 1 to 3 percent slopes
Go	Gomez loamy fine sand (W)
Gy	Gypsum land
Kb	Kimbrough loam
Ks	Kimbrough-Slaughter complex
Lp	Lipan clay
MdA	Midessa fine sandy loam, 0 to 1 percent slopes
MdB	Midessa fine sandy loam, 1 to 3 percent slopes
MmB	Miles loamy fine sand, 0 to 3 percent slopes (W)
PoA	Portales loam, 0 to 1 percent slopes
Pt	Potter soils
ReA	Reagan silty clay loam, 0 to 1 percent slopes
RvA	Reeves loam, 0 to 1 percent slopes
SaB	Sharvana fine sandy loam, 0 to 3 percent slopes
SfB	Simona fine sandy loam, 0 to 3 percent slopes
SlA	Slaughter loam, 0 to 1 percent slopes
SnB	Springer fine sandy loam, 1 to 3 percent slopes
SpB	Springer loamy fine sand, 0 to 3 percent slopes (W)
St	Stegall loam
Tf	Tivoli fine sand (W)
UpB	Upton loam, 1 to 3 percent slopes
Ur	Upton-Reagan complex
Ut	Upton gravelly loam, very shallow

MIDLAND COUNTY, TEXAS — SHEET NUMBER 1



This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

Photobase from 1962 aerial photographs. Grid values based on Texas plane coordinate system, central zone. 1927 North American datum.

Land division corners are approximately positioned on this map.

MIDLAND COUNTY, TEXAS NO. 1

MIDLAND COUNTY, TEXAS — SHEET NUMBER 2

Land division corners are approximately positioned on this map.

MIDLAND COUNTY, TEXAS NO. 2

Photobase from 1962 aerial photographs. Grid values based on Texas plane coordinate system, central zone. 1927 North American datum.

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MIDLAND COUNTY, TEXAS — SHEET NUMBER 3

(3)

N

887 000 FEET

1 473 300 FEET

(Joins sheet 2)

(Joins sheet 4)

(Joins sheet 7)

861 000 FEET

1 513 300 FEET

3 Miles

15000 Feet

2

10000

1

5000

0

1000

2000

3000

4000

5000

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Land division corners are approximately positioned on this map.

MIDLAND COUNTY, TEXAS NO. 3

4

N

MIDLAND COUNTY, TEXAS — SHEET NUMBER 4

3 Miles
2
1
0
¼
½
¾
1

15 000 Feet
10 000
5000
0
1000
2000
3000
4000
5000

Land division corners are approximately positioned on this map.

Photobase from 1962 aerial photographs. Grid values based on Texas plane coordinate system, central zone. 1927 North American datum.

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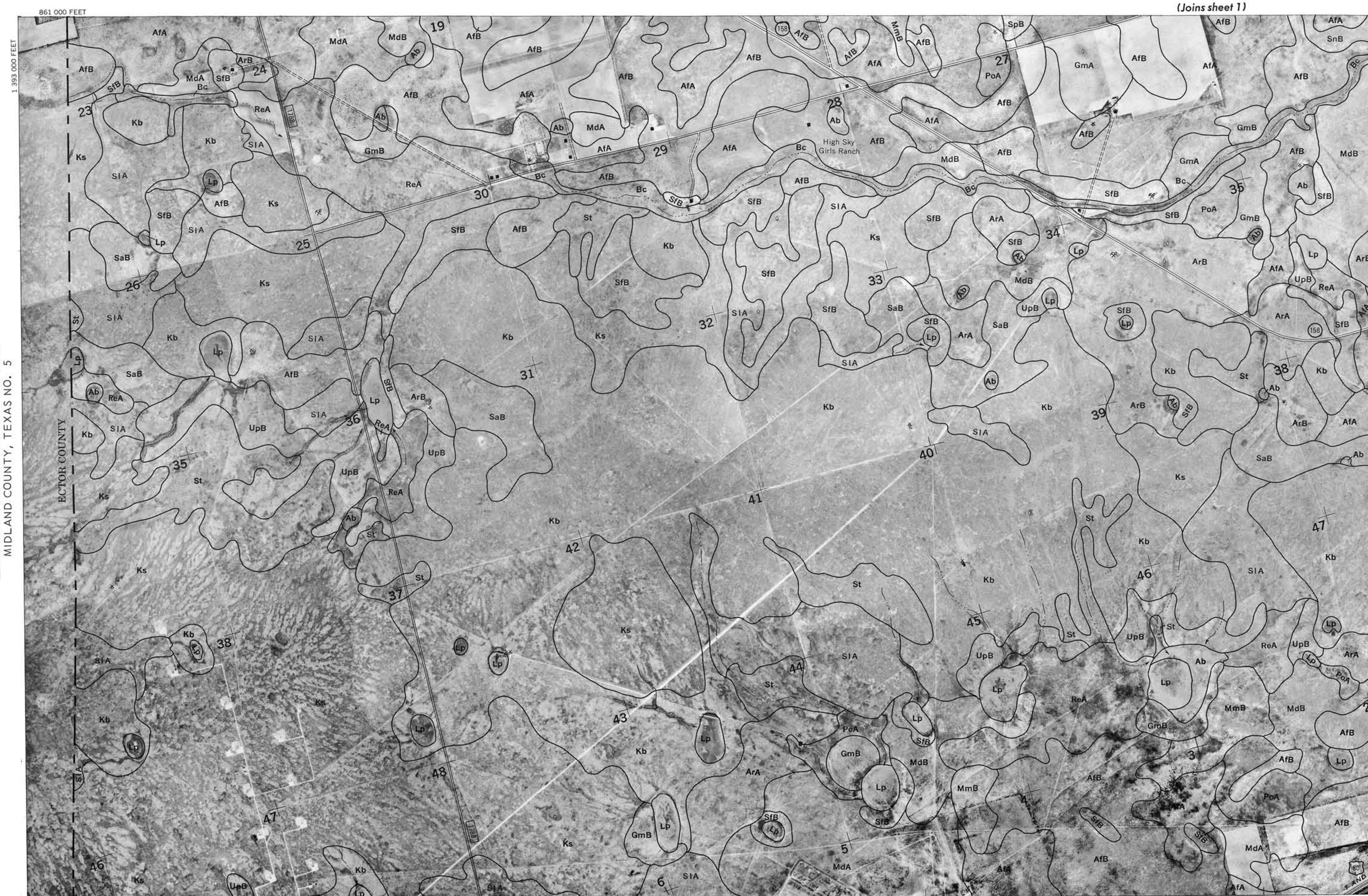
MIDLAND COUNTY, TEXAS NO. 4

5

(Joins sheet 1)



(Joins sheet 9)

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

Photobase from 1962 aerial photographs. Grid values based on Texas plane coordinate system, central zone. 1927 North American datum.

Land division corners are approximately positioned on this map.

MIDLAND COUNTY, TEXAS NO. 5

MIDLAND COUNTY, TEXAS — SHEET NUMBER 6

6

N

(Joins sheet 2)

861 000 FEET

1 473 300 FEET

3 Miles
15000 Feet
2
10000
1
5000
0
0
¼
½
¾
1
2000
3000
4000
5000

(Joins sheet 5)

(Joins sheet 7)

1 433 300 FEET

835 000 FEET

(Joins sheet 10)

Land division corners are approximately positioned on this map.

Photobase from 1962 aerial photographs. Grid values based on Texas plane coordinate system, central zone. 1927 North American datum.

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MIDLAND COUNTY, TEXAS NO. 6

7

MIDLAND COUNTY, TEXAS NO. 7

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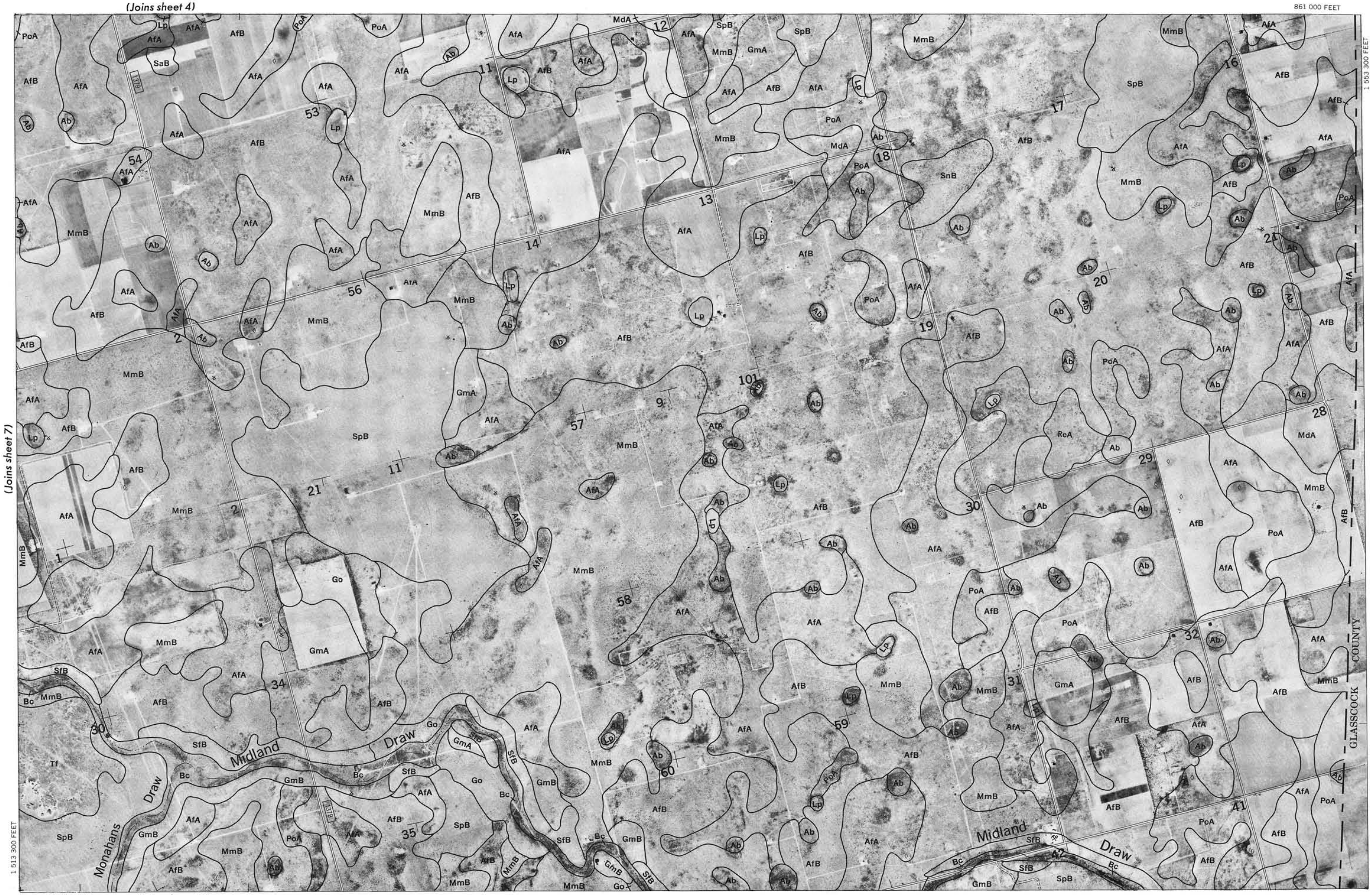
Photobase from 1962 aerial photographs. Grid values based on Texas plane coordinate system, central zone. 1927 North American datum.

Land division corners are approximately positioned on this map.

MIDLAND COUNTY, TEXAS — SHEET NUMBER 8

(Joins sheet 4)



(Joins sheet 12)

N

3 Miles
2
1
0
¼
½
¾
1

15000 Feet
10000
5000
0
2000
3000
4000
5000

Scale 1:20000

Land division corners are approximately positioned on this map.

Photobase from 1962 aerial photographs. Grid values based on Texas plane coordinate system, central zone. 1927 North American datum.

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9

(Joins sheet 5)

835 000 FEET

1 393 300 FEET

N

(Joins sheet 10)

(Joins sheet 13)

1 433 300 FEET

809 000 FEET

3 Miles | 2 | 1 | 0 | ¼ | ½ | ¾ | 1

15000 Feet | 10000 | 5000 | 0 | 1000 | 2000 | 3000 | 4000 | 5000

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

Photobase from 1962 aerial photographs. Grid values based on Texas plane coordinate system, central zone. 1927 North American datum.

Land division corners are approximately positioned on this map.

N

(Joins sheet 6)

835 000 FEET

1 473 300 FEET

3 Miles — 2 — 1 — 0 — ¼ — ½ — ¾ — 1

15000 Feet — 10000 — 5000 — 0 — 1000 — 2000 — 3000 — 4000 — 5000

(Joins sheet 9)

(Joins sheet 11)

(Joins sheet 14)

809 000 FEET

1 433 300 FEET

Land division corners are approximately positioned on this map.

Photobase from 1962 aerial photographs. Grid values based on Texas plane coordinate system, central zone. 1927 North American datum.

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11

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
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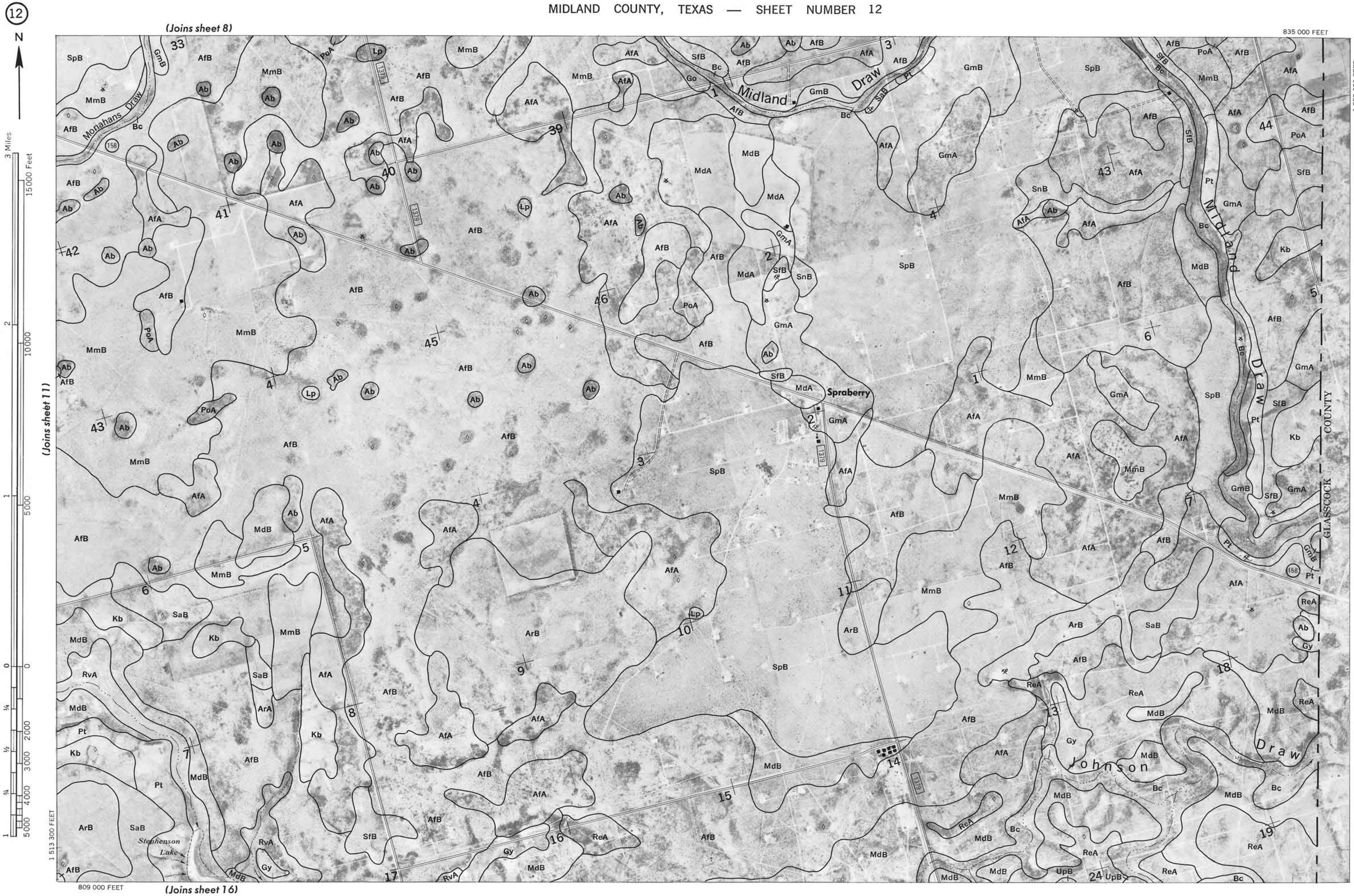
MIDLAND COUNTY, TEXAS NO.

MIDLAND COUNTY, TEXAS — SHEET NUMBER 12



Land division corners are approximately positioned on this map.

Photobase from 1962 aerial photographs. Grid values based on Texas plane coordinate system, central zone. 1927 North American datum.

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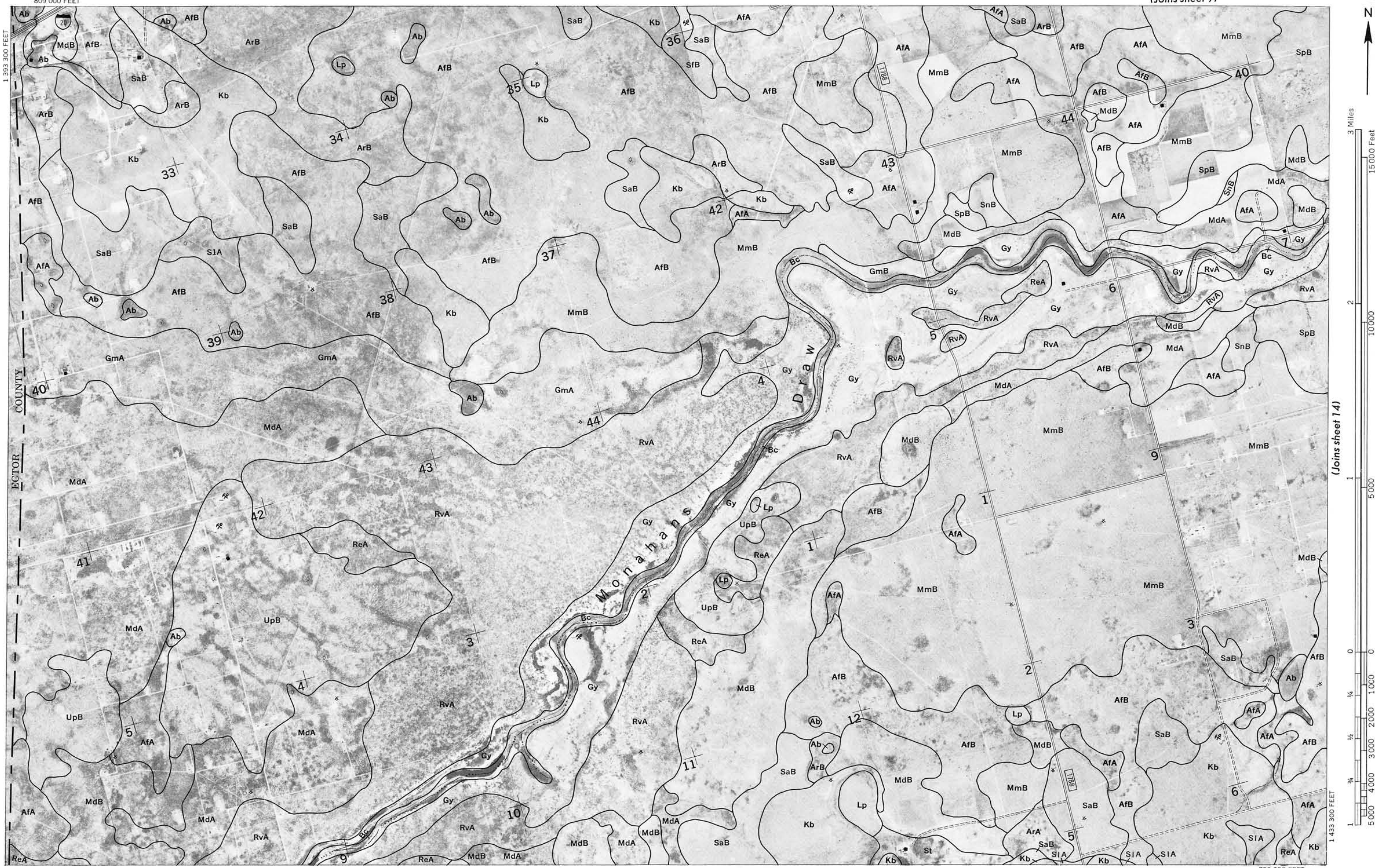
MIDLAND COUNTY, TEXAS NO. 12

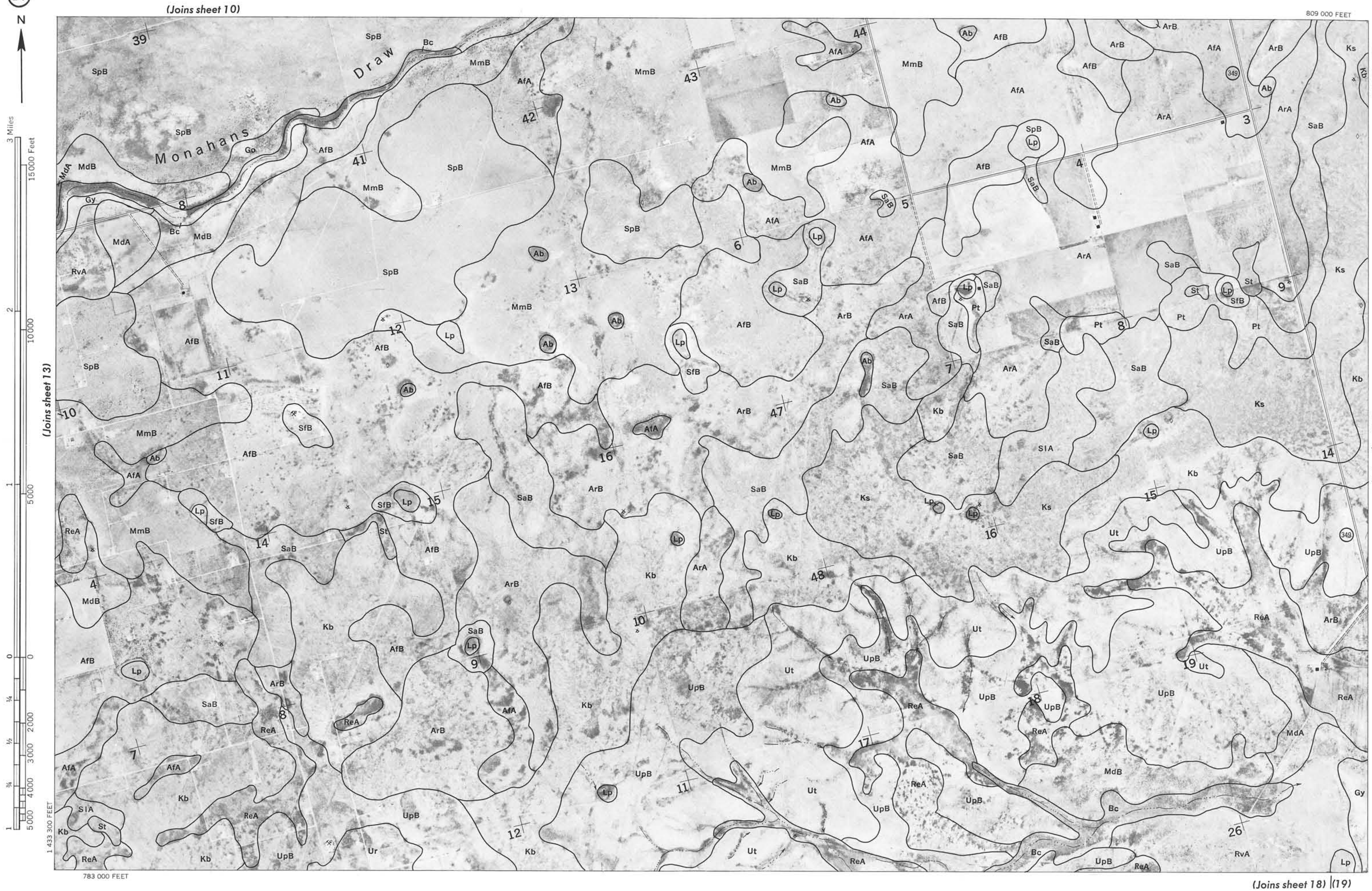
(Joins sheet 9)



(Joins sheet 17) | (18)

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1962 aerial photographs. Grid values based on Texas plane coordinate system, central zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

MIDLAND COUNTY, TEXAS — SHEET NUMBER 14



Land division corners are approximately positioned on this map.

Photobase from 1962 aerial photographs. Grid values based on Texas plane coordinate system, central zone. 1927 North American datum.

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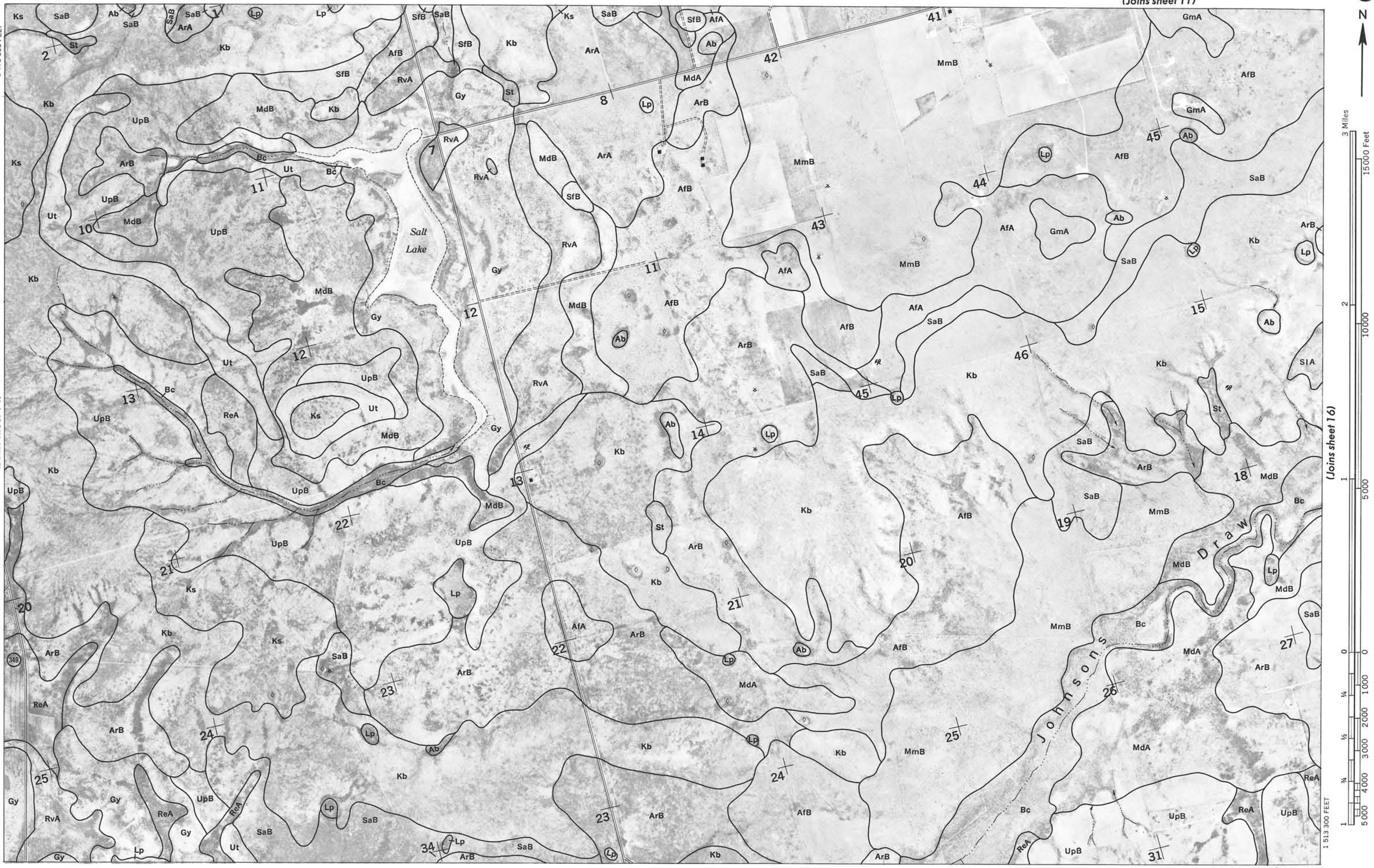
(Joins sheet 11)

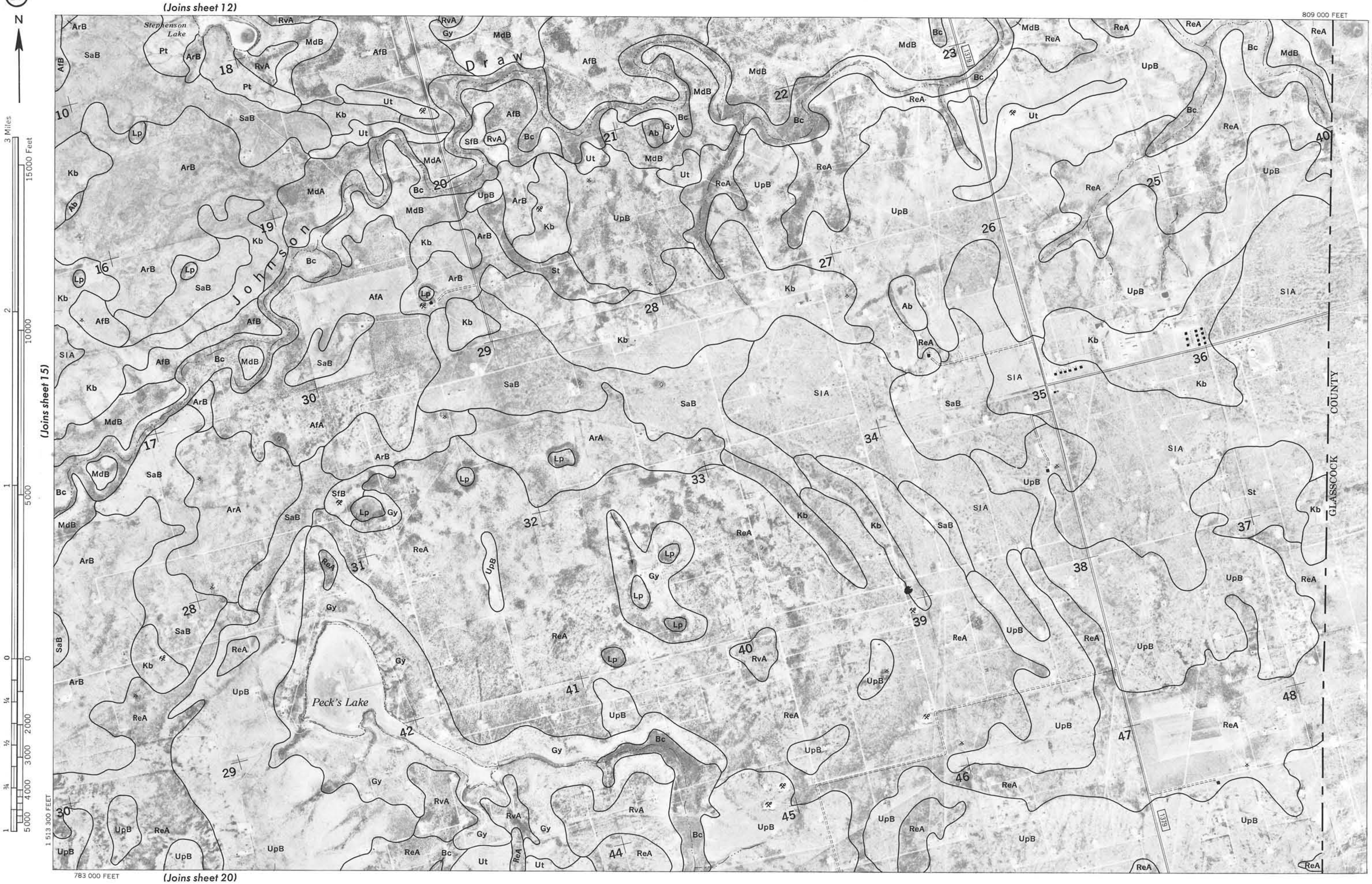


(Joins sheet 19) (20)

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1962 aerial photographs. Grid values based on Texas plane coordinate system, central zone. 1927 North American datum.
Land division corners are approximately positioned on this map.

(16)

MIDLAND COUNTY, TEXAS — SHEET NUMBER 16



Land division corners are approximately positioned on this map.

Photobase from 1962 aerial photographs. Grid values based on Texas plane coordinate system, central zone. 1927 North American datum.

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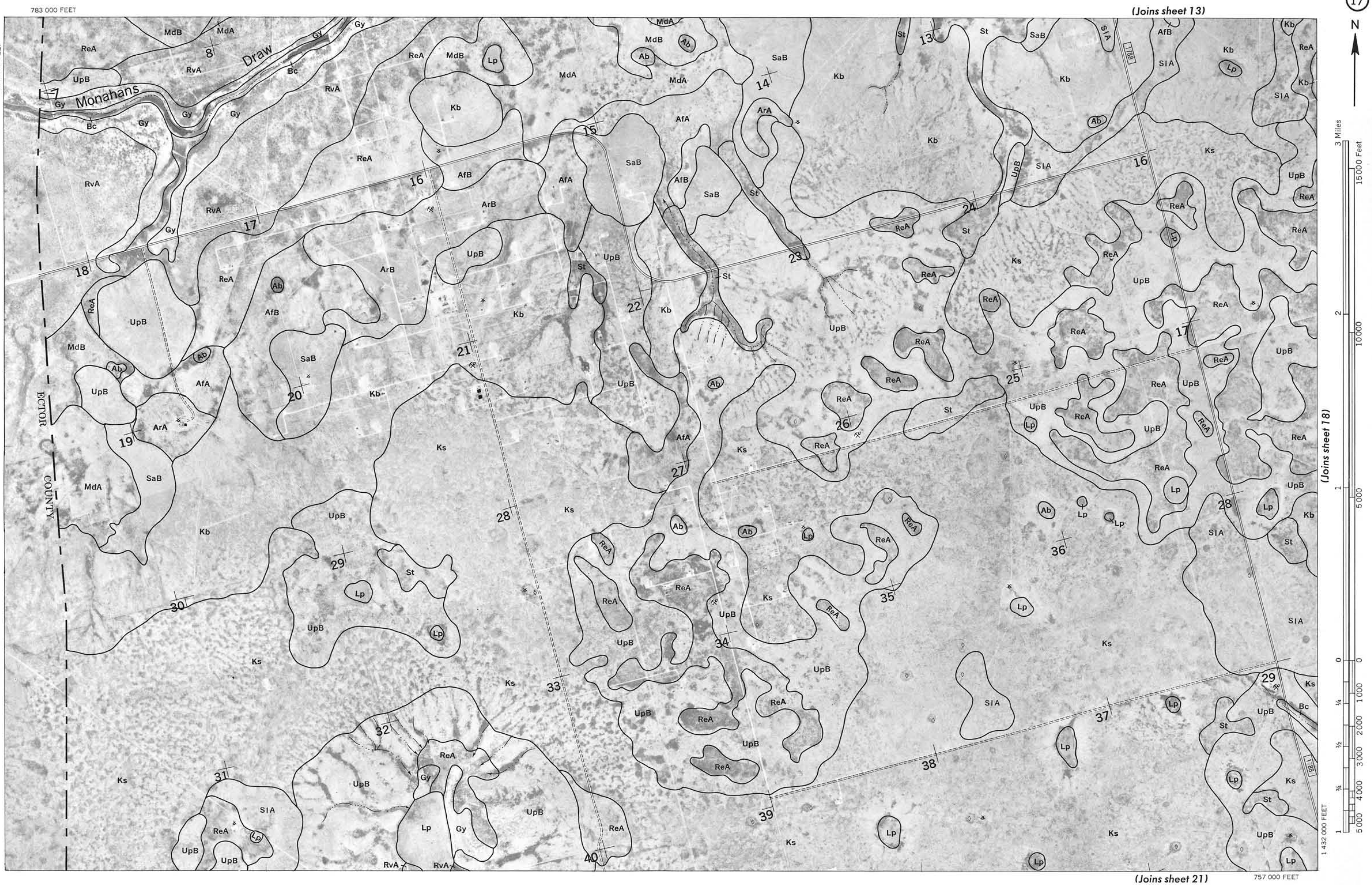

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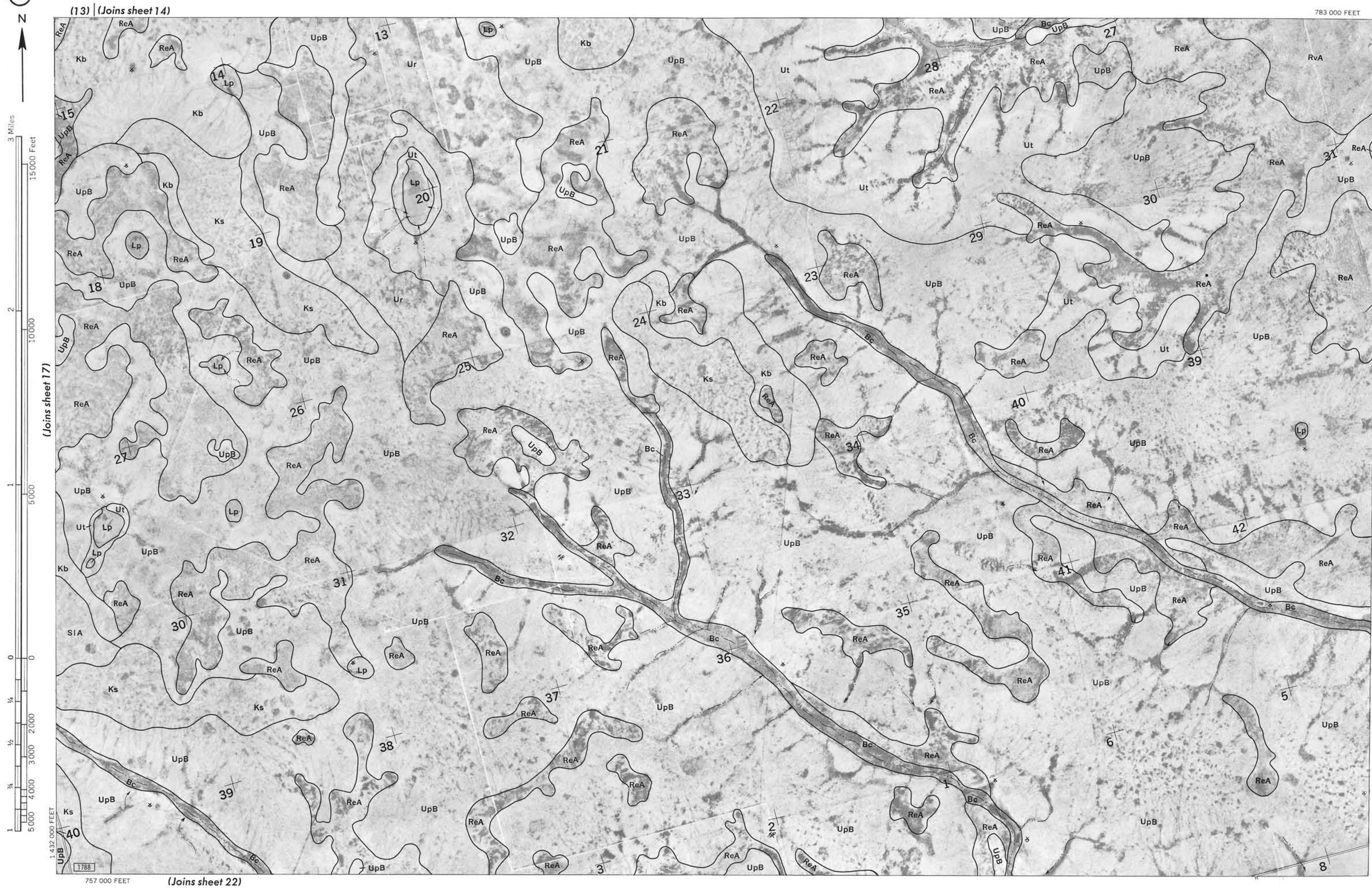

Land division corners are approximately positioned on this map.

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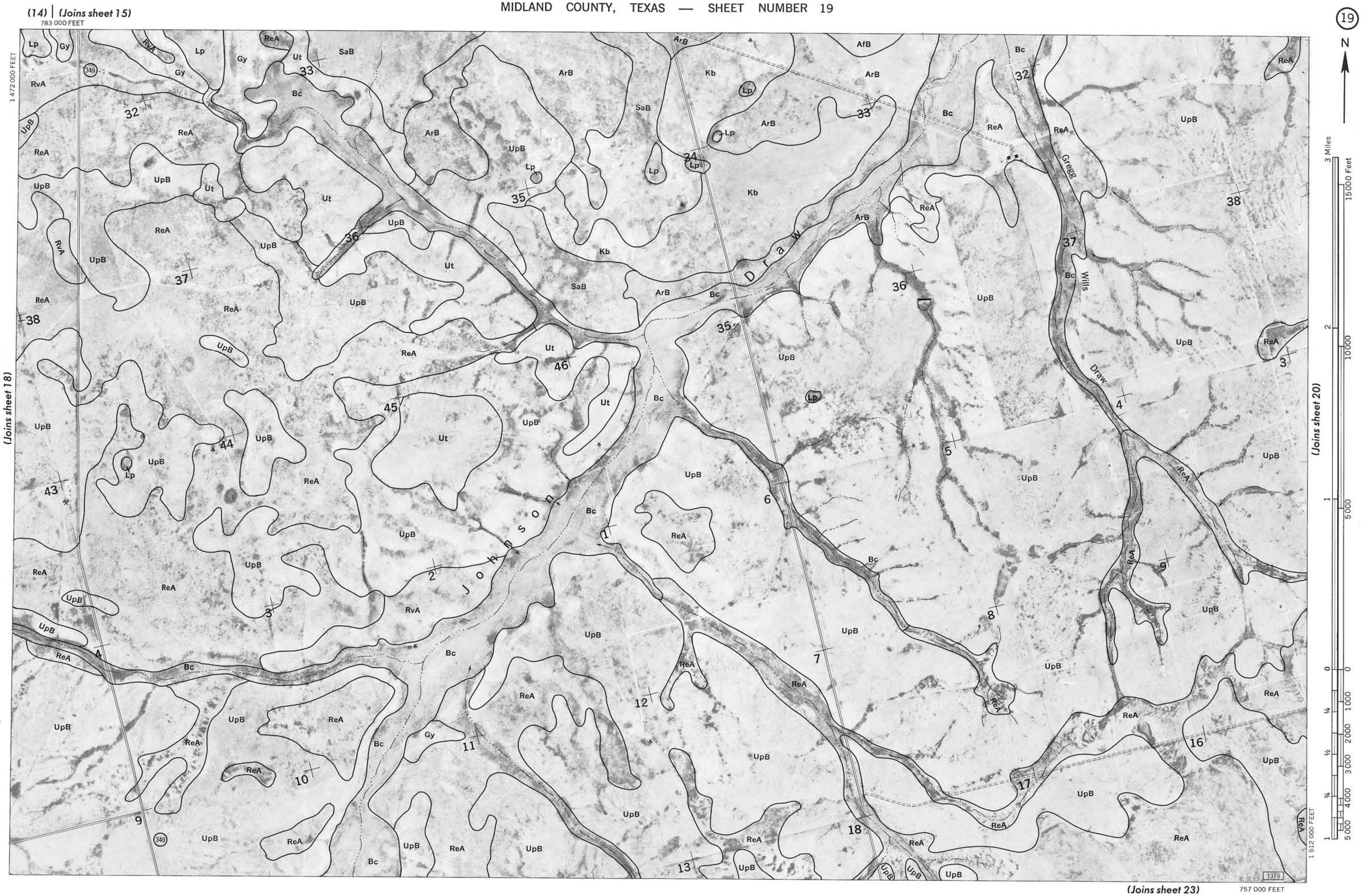

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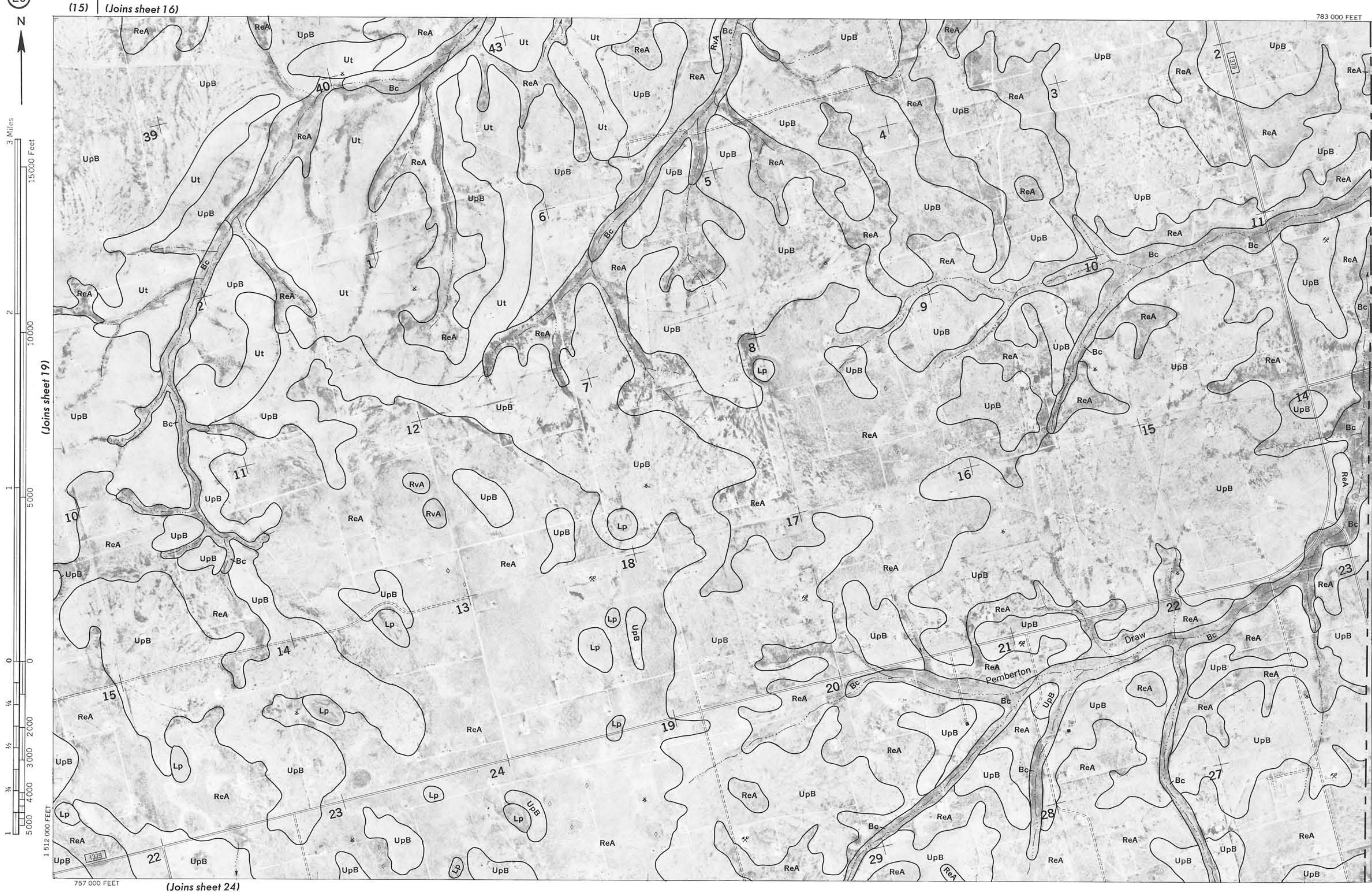
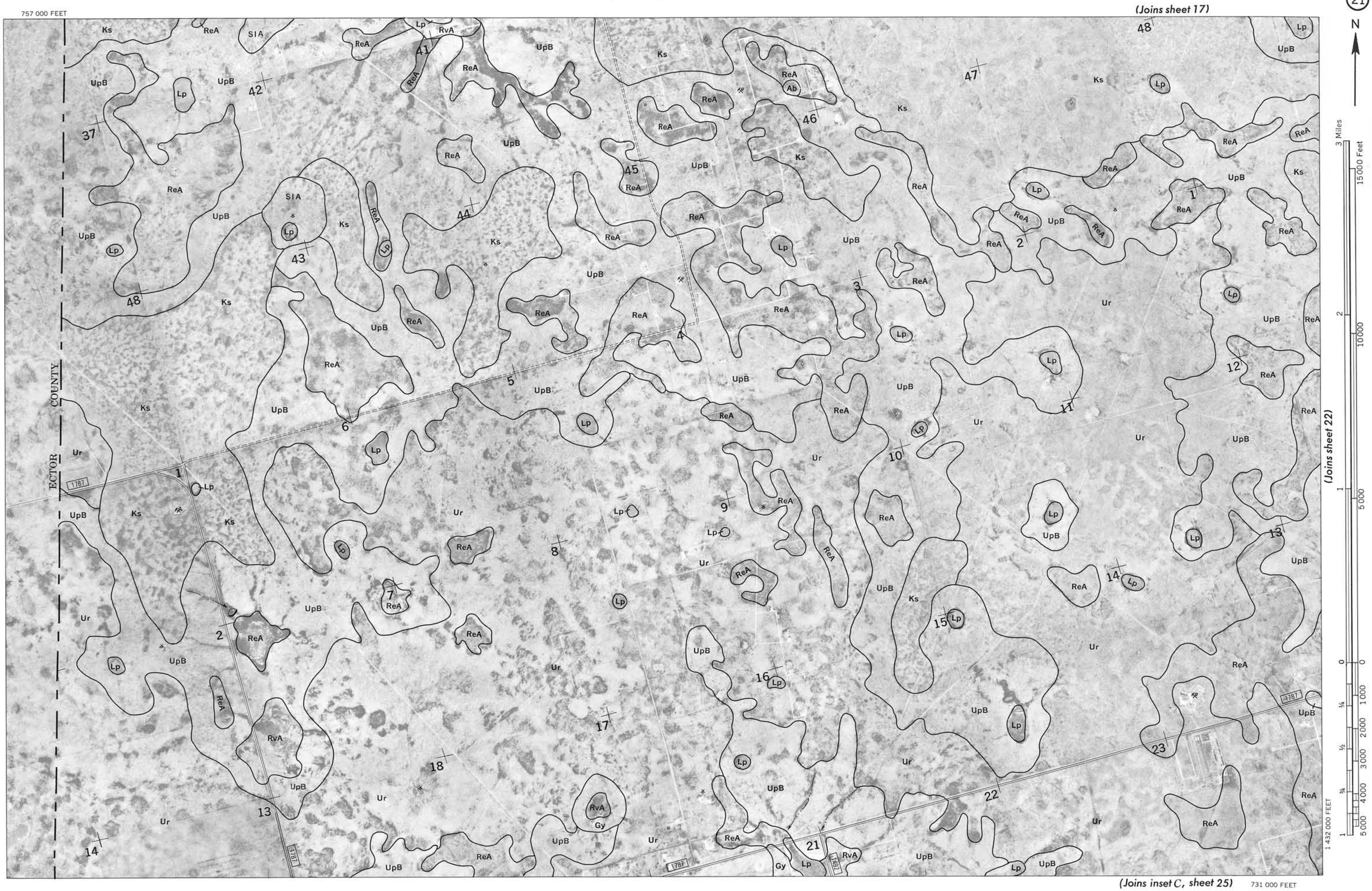
MIDLAND COUNTY, TEXAS NO. 19



Land division corners are approximately positioned on this map.
Photobase from 1962 aerial photographs. Grid values based on Texas plane coordinate system, central zone. 1927 North American datum.
This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

(21)



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Photobase from 1962 aerial photographs. Grid values based on Texas plane coordinate system, central zone, 1927 North American datum.

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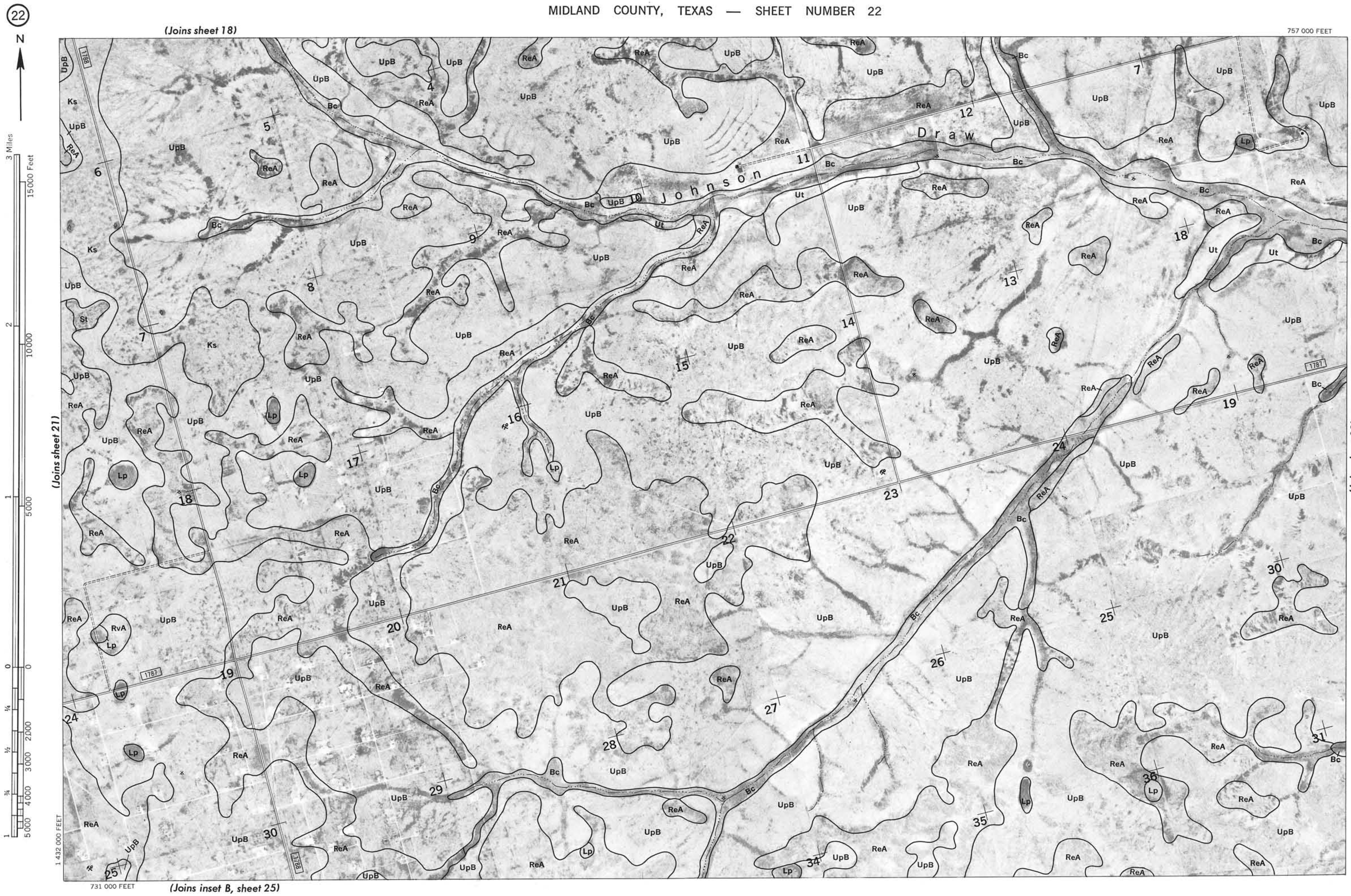

Land division corners are approximately positioned on this map.

Photobase from 1962 aerial photographs. Grid values based on Texas plane coordinate system, central zone, 1927 North American datum.

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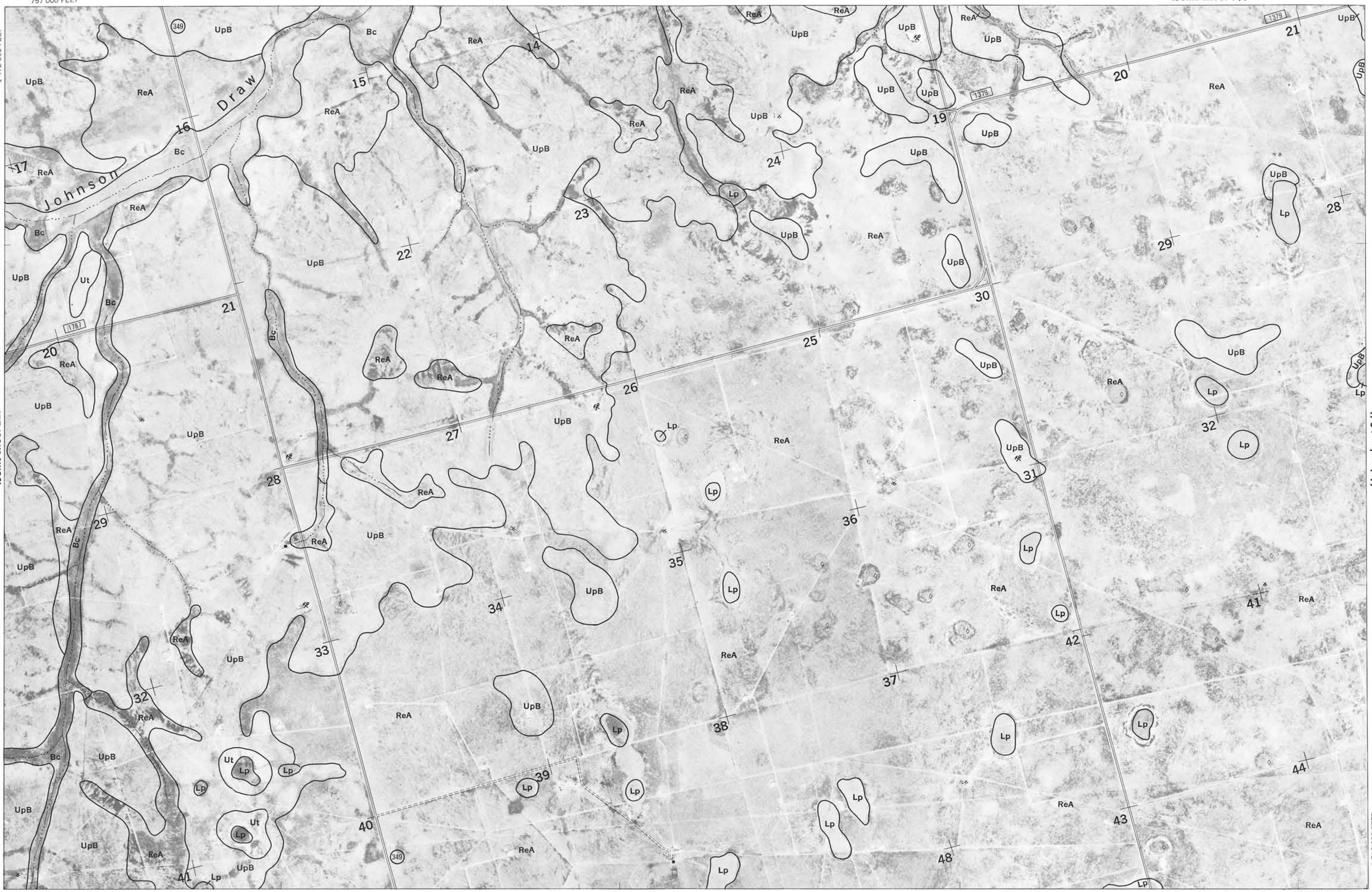
(Joins sheet 19)

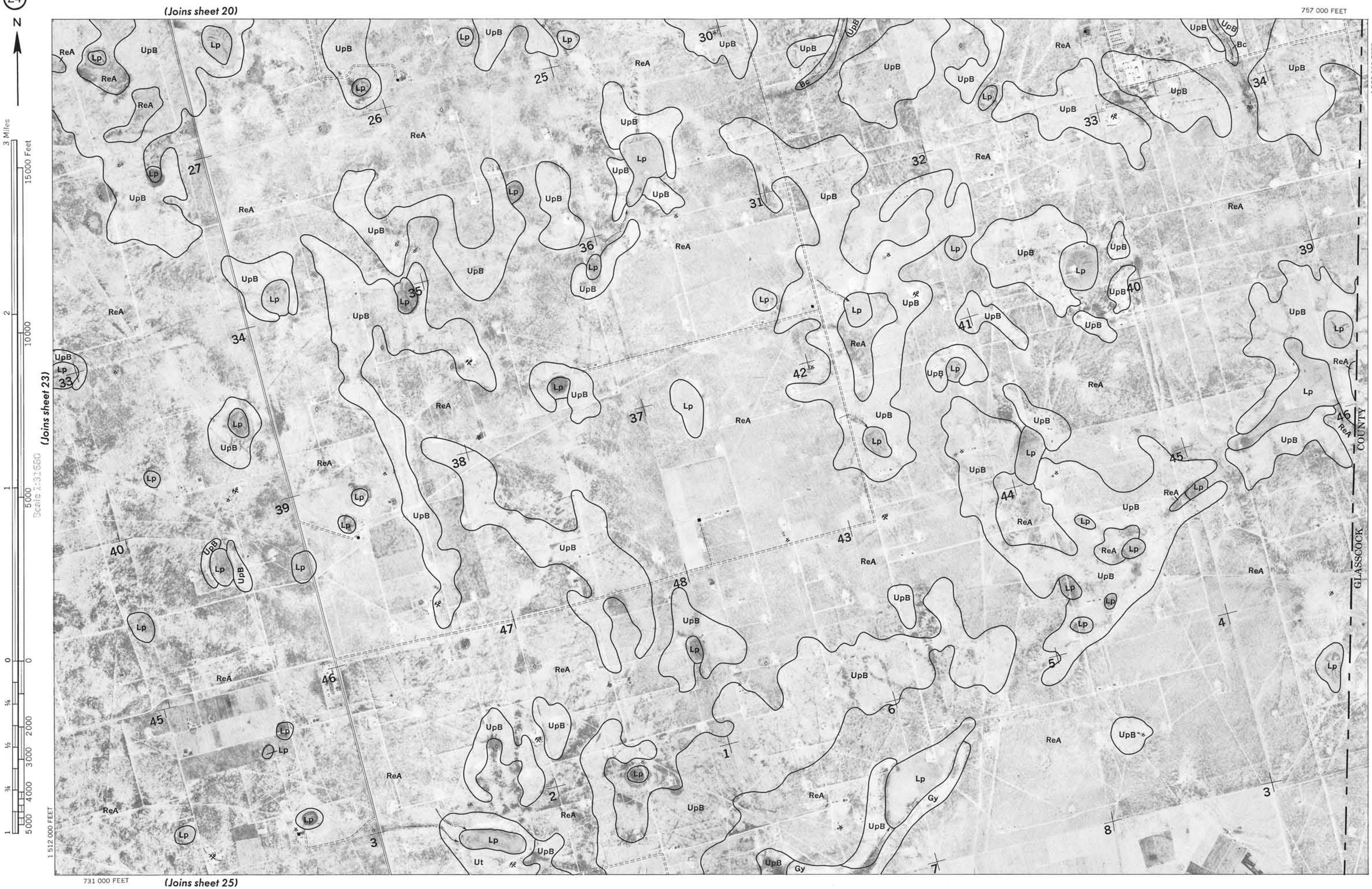


(Joins inset A, sheet 25)

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1962 aerial photographs. Grid values based on Texas plane coordinate system, central zone, 1927 North American datum.
Land division corners are approximately positioned on this map.

MIDLAND COUNTY, TEXAS NO. 23

MIDLAND COUNTY, TEXAS — SHEET NUMBER 24



Land division corners are approximately positioned on this map.

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MIDLAND COUNTY, TEXAS NO. 25